# MORPHOTAXONOMY OF PISCIAN CESTODES AND THEIR ECOLOGICAL STUDY IN **HETEROPNEUSTES FOSSILIS** (BLOCH.)

Thesis Submitted to the
Bundelkhand University, Jhansi
For the Degree of
Doctor of Philosophy
in
Zoology



BY

**NOOPUR MATHUR, M. Sc.**

Post Graduate Department of Zoology
Bipin Behari College, Jhansi (U. P.)

1992

# C O N T E N T S

## PART-C

PART-D

Dr. A.K. Srivastav
M.Sc., D.Phil.,F.A.Z.,
F.H.S., F.Z.S.I.,
Lecturer (Zoology)

Parasitological Laboratory,
Department of Zoology,
Bipin Behari College,
(Bundelkhand University),
Jhansi - 284 002.

# C E R T I F I C A T E

This is to certify that the thesis entitled, "MORPHOTAXONOMY OF PISCIAN CESTODES AND THEIR ECOLOGICAL STUDY IN HETEROPNEUSTES FOSSILIS (BLOCH.)" embodies the original research work of Smt. Noopur Mathur, who worked under the guidance and supervision of undersigned during 1989-1992 in the Department of Zoology, Bipin Behari College, Jhansi. The thesis has not been submitted for any degree to any other university.

DATE- 22.07.92

A Srivastav
( A. K. SRIVASTAV)

# PART-A

## ACKNOWLEDGEMENTS

This thesis that attempts to the taxonomy, morphology and ecology of cestode parasites is possible only with the unselfish collaboration of the many who contributed to the instant consequence of this challanging task.

The present work has been carried out in the P.G. Department of Zoology, Bipin Behari P.G. College, Jhansi under the able supervision of Dr.A.K.Srivastav, M.Sc., D.Phil., F.A.Z., F.H.S., F.Z.S.I. The author express deep gratitude and indebteness to her supesvisor for his untiring and kind interest in this project. Dr.Srivastav not only suggested the problems but also guided me at all stages of this work. His constant inspiration, and cordial treatment are greatly acknowledged.

The author prevails the previlage to thank to DR. V.C. Srivastav, C.M.P. College, Allahabad for several valuable suggestions for the project.

The author is thankful to the authorities of Bipin Behari P.G. College, Jhansi, perticularly to Dr. S.C.Shrotriy, Principal for being kind and considerate in allowing her for research work in the P.G. Department of Zoology.

The author express her deep gratitude to Dr.J.P.Tiwari, Head, Department of Zoology, Bipin Behari

P.G.College, Jhansi for providing library and laboratory facilities during the period of present project.

The author is greatful to Dr.S.C. Agrawal, Dr.U.K. Dwivedi, Dr.A.B.Gupta, Dr.R.C.Gupta, Dr.A.S.Gurdev, Department of Zoology, Bipin Behari P.G.College, Jhansi for their valuable suggestions in the preperation of the present manuscript.

It gives the author for considerable delight in thanking most willingly to her ideal teachers Dr. V.T.Sharma, Dr.O.P.Yadav and Dr.S.K.Dubey who cherished her Zoological knowledge to acheive this goal.

The author wish to record her appreciation to a good many individuals who, in a variety of ways helped herself in the course of the study. The author utter her deepest thanks to the following persons.

Dr. B.K.Srivastava (Asst. Malaria Officer), Mr.D.P. Singh (Sr. Technical Asst.,M.C.D. New Delhi), Mrs. Sunita Gupta, Miss Neena Chaturvedi, Mr. Atul Namdev, Mr.Hidayat, Mr. Ayub, Mr.Vimlesh Agarwal and Mr.Awadhesh Agarwal, Miss Madhuri Sharma, Miss Jayshree Sharma, Mr. Mahaveer Sharan Gupta and Mr. Karan Singh Yadav.

The author has no words to express his heart felt gratitude to Smt.Chhavikala Srivastav for her constant inspiration and affectionate treatment during the research period.

The author is also thankful to Shri R.K. Chaturvedi and Shri R.C.Srivastava, Lab assistants of Zoology Department of the Institute for their co-operation during this work.

The author feels extremely greatful to her in-laws Smt.and Shri M.B.Mathur, Parents Smt.and Shri V.B. Mathur,who very lovingly braught her up and gave her best possible education and supported at all stages of this project. The co-operation extended by her Bhaisahab and Bhabhiji Smt. and Shri R.B. Mathur, Jiji and Jijaji Smt. and Shri S.K. Mathur is also highly appreciable and greatly acknowledged.The author is also greatful to her sister Miss Lovely.

The author is deeply greatful to her husband Mr. Ajay B.Mathur for their untiring patience, deep appreciation, utmost passion and buoyancy. He has truly shared the pains of this innovative gestation, which was much longer than expected.

Thanks are also due to Mr. Pankaj Srivastav Director of IISM for carrying out excellent job in computerising this manuscript.

N.mathur.

DATE 22nd July 1992

NOOPUR MATHUR

# INTRODUCTION

A number of fresh water and marine fishes constitute highly nutritive food for human beings. Some of them are considered as delicacies. These edible fishes are known to harbour a number of cestode, nematode, trematode and acanthocephala parasites which cause deterioration in their health,hence their nutritive and market value is affected. The curiosity of the author to know about the helminth parasites found in such fishes lead her to undertake the present project.In the present thesis the author has restricted herself to the nature of infection of cestode parasites only. With a view to know the nature and extent of cestode infection, regular studies were under taken to record the nature of parasitism in fresh water cat fish, *Heteropneustes fossilis* (Bloch.) for two successive years. To have the idea of the state of infection in some fresh water and marine fishes the survey was conducted in different parts of district-Jhansi, Banda Kanpur,Raebareli,Puri (Orissa), Bombay (Maharashtra) and Goa. The present thesis deals with some of the interesting cestodes obtained during the survey which include the description of three new genera,one new subgenus,nine new species and redescription of one old species.

The new genera,new subgenus and new species belong

to the family Amphilinidae of the order Amphilinidea of the subclass Cestodaria, Lytocestidae and Capingentidae of the order Caryophyllidea, Ptychobothriidae of the order Pseudophyllidea, Phyllobothriidae of the order Tetraphyllidea, Proteocephalidae and Monticellidae of the order Proteocephalidea of the subclass Eucestoda.

A brief review relating to the cestode genera described in the thesis is given below.

The author in the present work devides the genus *Gigantolina* Poche, 1922 into two subgenera on the basis of shape of ovary viz. Gigantolina (Gigantolina) n.subgenus and Gigantolina (Unilobulata) n.subgenus. The first and only report of the genus pertains to that of *Gigantolina magna* Poche, 1922 in *Diagramma crassispinum*. The present new species *Gigantolina (Unilobulata) raebareliensis* n.sp. represents the first report of the subgenus from the Indian subcontinent and oriental region.

The genus *Monobothrioides* Fuhrmann *et* Baer, 1925 is currently represented by four species from whole world, the first report of the genus pertains to *Monobothrioides cunningtoni* Fuhrmann *et*.Baer, 1925 from *Aucheroglanis orientalis* in Tanganyika. All the species of this genus reported from continental region. *Monobothrioides* species is first time reported from Indian subcontinent and the oriental region.

The new genus *Bilobulata* n.g.represents the family Lytocestidae Hunter, 1927 of the order Caryophyllidea Beneden in Carus,1863. So far only fifteen genera have been reported from the family Lytocestidae Hunter, 1927 from the whole world.Out of them seven genus have been reported from the oriental region having five from Indian subcontinent. The present new genus is the sixth from Indian subcontinent.

The new genus *Mystoides* represents the family *Capingentidae* Hunter, 1930 of the order Caryophyllidea Beneden in Carus, 1863. So far only eight genera have been reported from the family Capingentidae from the whole world. Out of them four genera have been reported from the oriental region and Indian subcontinent. The present new genus is the fifth from Indian subcontinent.

The genus *Pseudolytocestus* Hunter,1929 is currently represented by two species from the Indian subcontinent and oriental region and three from the whole world. The first report of the genus pertains to *Pseudolytocestus differtus* Hunter,1929 in U.S..The first report from the Indian subcotinent is that of *Pseudolytocestus clariae* Gupta,1961 in *Clarius batrachus*. Present two new species are third and forth species of the genus from Indian subcontinent.

The new genus *Pseudoadenoscolex* represents the

family Capingentidae Hunter, 1930 of the order Caryophyllidea Beneden in Carus,1863. So far only eight genera have been reported from the family Capingentidae from the whole world. Out of them four genera have been reported from the oriental region and Indian subcontinent. The present new genus is the fifth from Indian subcontinent.

The genus *Circumoncobothrium* Shinde, 1968 is currently represented by five species from the oriental region and Indian subcontinent. None is reported from continental region. The first report of the genus pertains to *Circumoncobothrium ophiocephali* Shinde, 1968. From *Ophiocephalus leucopunctatus* in India. *Circumoncobothrium capoori n.sp. described* here with represents the sixth species of the genus from Indian subcontinent and oriental region.

The genus *Senga* Dollfus, 1934 is currently represented by five species from oriental region and three from Indian subcontinent. None is reported from continental region. The first report of the genus pertains to *Senga besnardi* Dollfus, 1934 from *Ophiocephalus gachua* in India. *Senga jhansiensis* n.sp. described here with represents the forth species of the genus from Indian subcontinent.

The genus *Anthobothrium* Beneden, 1850 is currently represented by nine species from oriental region,out of them seven

from Indian subcontinent and nineteen form continental region. The first report of the genus pertains to *Anthobothrium cornucopia* Beneden,1850 from marine sharks of Atlantic and Mediterranean sea. Other workers in the oriental region who have contributed to the knowledge of this cestode genus are Shipley (1900), Shipley *et* Hornell(1909), Subhapradha (1957), Shinde,Jadhav *et* Mohekar(1981), Srivastav *et* Capoor (1980) and Srivastav *et* Srivastava 1988.

The genus *Gangesia* Woodland, 1924 is currently represented by eight species from oriental region out of them seven from Indian subcontinent and four from continental region. The first report of the genus pertains to *Gangesia bengalensis* (Southwell, 1913) Woodland, 1924 from *Ophiocephalus striatus*, *Labeo rohita*, *Wallago attu* in India and Pakistan. *Gangesia Chauhani* n.sp. described here with represents the seventh species of the genus from Indian subcontinent.

The genus *Nomimoscolex* Woodland, 1934 is currently represented by seven species from contiental region. The first report of the genus pertains to *Nomimoscolex piraeeba* Woodland, 1934 from *Brachyplatystoma filamentosum* in Amazon river. *Nomimoscolex shrotrii* n.sp. described here with repesents the first species of the genus from oriental region and Indian subcontinent.

With a view to discover the cestode host relation

ships, examination of the fresh water cat fish *Heteropneustes fossilis* (Bloch.) has been performed for two successive years. The prevalence, mean intensity and relative density of cestode infection has been worked out, in relation to the body weight, sex of the host and cloacal temperature of the host.

## HISTORICAL

Several workers have contributed to the Knowledge of cestode taxonomy from the Indian subcontinent. From Sri Lanka Shipley and Hornell have described many papers. They include *Tetrarhynchus balistidis* (1904), *Tetragonocephalum trigonis* (1905), *Tylocephalum aetiobatidis* (1905), *Carpobothrium chiloscyllii* (1906), *Cephalobothrium aetiobatidis* (1906), *Echeneibothrium ceylonicum* (1906), *Echeneibothrium trifidum* (1906), *Echeneibothrium trigonis* (1906), *Eutetrarhynchus leocomelanum* (1906), *Halysiorhynchus macrocephalus* (1906), *Myzophyllobothrium rubrum* (1906), *Nybelinia equidentata* (1906), *Nybelinia pirideraea* (1906), *Nybilinia trigonis* (1906), *Phyllobothrium minutum* (1906), *Phyllobothrium pammicrum* (1906), *Polypocephalus pulcher* (1906), *Pterobothrium platycephalum* (1906), *Tylocephalum dierama* (1906), and *Tylocephalum translucens* (1906).

Southwell's contribution has been classical. Apart from his classical volume of "Fauna of British India", his pioneering contributions include the descriptions of many new species. In 1913 Southwell reviewed the cestode material then existing in the Indian museum collection. The review included the description of twenty species and the redescription of some known species *Anthobothrium lintoni* (1911), *Calycobothrium typicum*

(1911), *Echinobothrium boisii* (1911), *Hexacanalis abruptus* (1911), *Hexacanalis variabilis* (1911), *Onchobothrium formeri* (1911), *Pithnophorus tetraglobus* (1911),*Tetrarhynchus spinuliferum* (1911), *Acanthobothrium herdmani* (1912), *Otobothrium linstowi*( 1912), *Phyllobothrium floriforme* (1912), *Gangesia bengalensis* (1913), *Gigantolina magna*(1915),*Poecilancistram ilisha* (1918 with Prasad), *Phyllobothrium compactum* (1920 with Prasad),*Acanthobothrium macracanthum* (1925), *Balanobothrium parvum* (1925) *Echinobothrium longicolle* (1925), *Phyllobothrium centrurum* (1925), *Tylocephalum minutum* (1925), *Tylocephalum yorkei* (1925), *Phyllobothrium dagnallium* (1927), *Phyllobothrium microsomum* (1929 with Hilmy). The other important contribution of Southwell from fish hosts include *Otobothrium balli* (1929), *Tentacularia macfiei* (1929), *Tentacularia obesa* (1929), *Tentacularia pillersi* (1929), *Tetrarhynchus matheri* (1929), *Tetrarhynchus ceylonicus* (1929). It will not be an exaggeration to say that his contributions gave great stimulus and a direction to the study of cestodes in this subcontinent and its neighbourhood.

The important contribution of Woodland comprise *Amphilina paragonopora* (1923), *Lytocestus filiformes* (1923), *Wenyonia virilis* (1923),*Wenyonia acuminata* (1923), *Wenyonia minuta* (1923), *Caryophyllaeus chalmarsius* (1924), *Gangesia macrons*(1924), *Gangesia wallago* (1924), *Senga pycnomere* (1924), *Marsipocephalus heterobranchus* (1925), *Anthobothrium karuatayi* (1934),

*Anthobothrium piramutab* (1934), *Anthobothrium pristis* (1934), *Endorchis piraeeba* (1934), *Megathylacus jandia* (1934), *Proteocephalus jandia* (1934) *Myzophorus admonticellia* (1934), *Nomimoscolex piraeeba* (1934), *Nomimoscolex kaparari* (1935), *Nomimoscolex lenha* (1935), *Nomimoscolex piractinga* (1935), *Nomimoscolex sudobim* (1935), *Endorchis mandube* (1935), *Proteocephalus kuyukuyu* (1935), *Myzophorus dorad* (1935), *Myzophorus pirara* (1935), *Myzophorus sudobim* (1935), *Stocksia punjehuni* (1937), *Stocksia lezera* (1937), *Proteocephalus bivitellatus* (1937).

The important contribution of Dollfus comprise *Senga besnardi* (1934), *Senga ophiocephalina* (1934), *Senga pycnomera* (1934), *Eutetrarhynchus leucomelanus* (1942), *Pterobothrium platycephalum* (1942), *Pterobothrium rubromaculatum* (1942) and *Nybelinia alloiolica* (1960).

Subhapradha's voluminous work includes species of cestodes from fishes collected from Indian sea coasts, viz. *Polypocephalus affinis* (1951), *Polypocephalus caronatus* (1951), *Polypocephalus lintoni* (1951), *Polypocephalus rhinobatidis* (1951), *Polypocephalus rhynchobatidis* (1951), *Polypocephalus vitellaris* (1951), *Oncodiscus fimbriatus* (1955), *Acanthobothrium indicum* (1957), *Acanthobothrium rhynchobatidis* (1957), *Acanthobothrium southwelli* (1957), *Anthobothrium crenulatum* (1957),

*Anthobothrium septatum* (1957), *Anthobothrium spinosum* (1957), *Cephalobothrium rhinobatidis* (1957), *Echeneibothrium filamentosum* (1957), *Echeneibothrium verticillatum* (1957), *Eulacistorhynchus chilocyllius* (1957), *Otobothrium minutum* (1957), *Phyllobothrium chiloscyllii* (1957), *Phyllobothrium minimum* (1957), *Phyllobothrium typicum* (1957), *Pithophorus musculosus* (1957). He established two new genera viz. *Anteropora* and *Eulacistorhynchus.*

Gupta,S.P.described many known and unknown cestodes from U.P. His important contribution are *Lucknowia follilisi* (1961), *Capingentoides batrachii* (1961), *Pseudolytocestus clariae* (1961), *Pseudocaryophyllaeus indica* (1961), *Capingentoides batrachaii* (1961), and *Capingentoides heteropneusti* (1980 with sinha).

Shinde, G.B. described a number of known and unknown cestodes. His important contributions are *Circumoncobothrium ophiocephali* (1968), *Lytocestoides aurangabadensis* (1970), *Circumoncobothrium raoii* (1976 with Jadhav), *Uncibilocularis southweli* (1976 with Chincholikar), *Circumoncobothrium khamii* (1977), *Circumoncobothrium shindei* (1977 with Chincholikar), *Scyphophyllidium arabiansis* (1977 with Chincholikar), *Pithophorus yamagutii* (1978), *Flapocephalum saurashtri* (1979 with Deshmukh), *Pedibothrium lintoni* (1980), *Pedibothrium vervalensis* (1980 with Jadhav and Deshmukh),

*Anthobothrium veravalensis* (1980 with Jadhav and Mohekar), *Marsupiobothrium rhinobati* (1980 with Deshmukh), *Marsupiobothrium rhynchobati* (1980 with Deshmukh), *Echeneibothrium smitii* (1981 with Deshmukh and Jadhav), *Polypocephalus alii* (1981 with Jadhav), *Polypocephalus katpurensis* (1981 with Jadhav), *Polypocephalus singhii* (1981 with Jadhav), *Polyopocephalus thapari* (1981 with Jadhav), *Mixophyllobothrium obamuri* (1981 with Chincholikar). Chincholikar with shinde describes *Gymnorhynchus cybiuni* (1977), *Circumoncobothrium bagariusi* (1977), *Eniochobothrium trygonis* (1978) and *Ptychobothrium clupeoidesii* (1976 with Deshmukh). Jadhav with Shinde describes many species viz. *Balanobothrium veravalensis* (1979), *Oncodiscuscus maharashtrae* (1981), *Uncibilocularis veravalelnsis* (1981), *Echeneibothrium karbharae* (1981 with Deshmukh). Deshmukh describes *Flapocephalum trygonis* (1979), *Yorkeria southwelli* (1979) *Platybothrium veravalensis* (1977 with Shinde and Jadhav).

The investigations of Zaidi and Khan ranged over Pakistan. His important contributions comprise *Bovienia ilishai* (1976), *Hornelliella palasoorahi* (1976), *Senga taunsaensis* (1976), *Thysanocephalum karachii* (1976), *Pithophorus pakistanensis* (1976) and *Vermaia sorrakowahi* (1976).

Srivastav, A.K. with Capoor, V.N. describes *Phyllobothrium bombayensis*(1979),*Acanthobothrium mylobatinus*(1979),

*Acanthobothrium dighaensis* (1980), *Anthobothrium hanumanthi* (1980),*Hexacanalis sassoonensis* (1980), *Phoreiobothrium puriensis* (1982). Srivastav, A.K.with Tiwari, J.P. describes *Oncobothrium capoori* (1980) and Srivastav A.K. with Srivastava, B.K. *Anthobothrium sasoonanse* (1988) and *Phyllobothrium blochii* (1988).

Bilquees contribution from Pakistan includes *Myrmillorhynchus pearsoni* (1980), and three species of *Acanthobothrium*. Shah with Bilquees in 1979 described *Nybelinia elongata*.

Besides the major contributions of the afore said workers a number of stray papers have been published by Linstow (1904), Linton (1909), Poche (1922), Moghe (1925 and 1926), Verma (1928), Mehra (1930), Yamaguti (1954 and 1959), Johri (1956 and 1959), Linsdale (1956), Fotedar (1958 and 1974), Murhar (1964), Khalil (1971), Verma (1971), Pandey (1973), Rama (1973), Satpute *et* Agarwal (1974 and 1980), Singh (1975), Sahay *et* Sahay (1977), Blair (1978), Reimer (1980) and Malhotra (1980 and 1981).

# MATERIAL AND METHODS

The alimentary canal of the host was removed and cut open in normal saline water in troughs or petridishes. It was lightly shaken and the contents decanted several times. The intestine and its contents containing parasites were examined thoroughly under a binocular microscope to ensure that none of the parasite is left behind. In some cases,as the scolices were deeply embedded, it was found necessary to take them out by scraping the mucosa of the intestine with a sharp scalpel or by releasing the scolices with a pair of needles. Later, portion of the mucosa attached to the cestode body was removed by shaking the body of the cestode in the normal saline water. The worms were stretched in luke warm water and in case of larger worms, by lifting them with the help of needles or forceps against the edges of petridishes repeatedly for several times and later on fixed in 5% formalin or alcoholic Bouin's fluid. Fixed and washed worms were stored in 5% formolin till needed for study.

The whole mounts were stained in either Borax carmine or Mayer's Haemalum. The Mayer's Haemlum proved to be the best stain for cestodes. Whole mounts were either cleared in xylol or clove oil. For sectioning, the material was cleared in xylol, embedded in histowax and cut at 0.006-0.008mm,stained with Delafield's Haematoxyline and Eosin and mounted in canada balsam.

The worms have also been studied in living conditions.

Only camera lucida drawings were made. All the measurements have been given in millimeters unless otherwise stated. Averages taken on the basis of the study of five to ten worms except in cases where still fewer worms were obtained.

During the course of study the total number of hosts thus examined was 225. The hosts examined belong to 19 species of fishes.

For the study of cestode host relationship, the "singhi" fish *Heteropneustes fossilis* (Bloch.) was selected. The live fishes were obtained through local fish catchers. A thorough study of five fishes were made in a month. This was continued for two successive years from February 1989 to January 1991.

Following process was used in the study of cestode host relationship.

*(a)* Live fishes were weighed individually.

*(b)* The strings of fish was removed with the help of bone cutter and quickly dissected to find out the sex by locating the testes or ovary.

*(c)* The alimentary canal of the fish was cut open in the normal saline solution in a petridish.

*(d)* The four kinds of parasites viz. cestodes, nematodes, trematodes and acanthocephala were collected and counted

separately in each infection.

*(e)* The morphological studies of the cestodes, thus obtained were performed and their diagnosis completed on the basis of the study of permanent stained slides.

A total number of 112 *Heteropneustes fossilis* (Bloch.) were examined and 32 of them were found infected. Eighty fishes were found negative for helminth infection. The total number of 88 helminth parasites were obtained which included 26 cestodes, 20 nematodes, 2 trematodes and 40 acanthocephala.

During the ecological studies prevalence, mean intensity and relative density were calculated the definitions given by Morgolis *et al.*, 1982 were followed.

1. *PREVALENCE :* Number of individuals of a host species infected with a particular parasite species divided by number of hosts examined.

$$\text{prevalence} = \frac{\text{Number of hosts infected}}{\text{Number of hosts examined}}$$

2. *MEAN INTENSITY :* Total nuber of individuals of a particular parasite species in a sample of a host species divided by number of infected individuals of the host species in the sample.

$$\text{Mean intensity} = \frac{\text{Total number of cestodes obtained}}{\text{Total number of hosts infected}}$$

3. *RELATIVE DENSITY* : Total number of individuals of a particular parasite species in a sample of host divided by total number of individuals of the host species.

$$\text{Relative density} = \frac{\text{Total number of cestodes obtained}}{\text{Total number of hosts examined}}$$

Prevalence, Mean intensity and Relative density of cestode parasites were calculated,annual, season wise and month wise in relation to the following parameters.

*(a)* Body weight of the host.

*(b)* Sex of the host.

*(c)* Cloacal temperature of the host.

HOST PARASITE LIST

| Hosts | Number examined | Number infected | Cestodes obtained |
|---|---|---|---|
| *Bugarius bugarius* | 4 | - | - |
| *Channa marulius* | 10 | - | - |
| *Channa punctatus* | 5 | - | - |
| *Channa striatus* | 8 | - | - |
| *Clarius batrachus* | 14 | 5 | *Bilobulata georgievi* *n.g.,n.*sp. |
| | | | *Pseudolytocestus pandei* n.sp. |
| *Heteropneustes fossilis* | 112 | 12 | *Nomimoscolex shrotrii* n.sp. |
| | | | *Pseudoadenoscolex fossilis* n.g.,n.sp. |
| *Lobeo calbasu* | 4 | - | - |
| *Labeo gonius* | 6 | - | - |
| *Mastacembelus armatus* | 10 | 4 | *Circumoncobothrium capoori* n.sp. |
| | | | *Senga jhansiensis* n.sp. |
| *Mystus aor* | 6 | 2 | *Mystoides bundelkhandensis* n.g.,n.sp. |
| | | | *Pseudolytocestus dayali* n.sp. |

| | | | |
|---|---|---|---|
| *Mystus tengra* | 2 | 1 | *Gigantolina (Unilobulata) raebareliensis* n.subg.,n.sp. |
| *Notopterus notopterus* | 4 | 1 | *Monobothrioides woodlandi* Mackiewicz and Beverly Burton 1967. |
| *Ompak bimaculatus* | 4 | - | - |
| *Puntius sarana* | 5 | - | - |
| *Rita rita* | 3 | - | - |
| *Scoliodon sorrakowah* | 12 | 4 | *Anthobothrium puriensis* n.sp. |
| | | | *Anthobothrium srivastavai* n.sp. |
| *Wallago attu* | 4 | 2 | *Gangesia chauhani* n.sp. |
| *Xenantodon cancila* | 8 | - | - |
| *Zygaena blochii* | 4 | 1 | *Anthobothrium blochii* n.sp. |

## CLASSIFIED LIST OF CESTODE PARASITES DESCRIBED IN THE THESIS

| | |
|---|---|
| Class : | Cestoda |
| Subclass : | Cestodaria Monticelli, 1891 |
| Order : | Amphilinidea Poche, 1922 |
| Family : | Amphilinidae Claus, 1879 |
| Genus : | *Gigantolina* Poche, 1922 |
| Subgenus : | *Unilobulata* n.Subg. |
| Species : | *Gigantolina (Unilobulata) raebareliensis* n.subg.,n.sp. |
| Subclass : | Eucestoda Southwell, 1930 |
| Order : | Caryophyllidea Beneden in Carus, 1863 |
| Family : | Lytocestidae Hunter, 1927 |
| Genus : | *Monobothrioides* Fuhrmann *et* Baer, 1925 |
| Species : | *Monobothrioides woodlandi* Mackiewicz *et* Beverley Burton, 1967. |
| Genus : | *Bilobulata* n.g. |
| Species : | *Bilobulata georgievi* n.g.,n.sp. |
| Family : | Capingentidae Hunter, 1930 |
| Genus : | *Mystoides* n.g. |
| Species : | *Mystoides bundelkhandensis* n.g.,n.sp. |
| Genus : | *Pseudolytocestus* Hunter, 1929 |
| Species : | *Pseudolytocestus dayali* n.sp. |
| Species : | *Pseudolytocestus pandei* n.sp. |
| Genus : | *Pseudoadenoscolex* n.g. |

Species : *Pseudoadenoscolex fossilis* n.g.,n.sp.

Order : Pseudophyllidea Carus, 1863

Family : Ptychobothriidae Luhe, 1902

Genus : *Circumoncobothrium* Shinde, 1968

Species : *Circumoncobothrium capoori* n.sp.

Genus : *Senga* Dollfus, 1934

Species : *Senga jhansiensis* n.sp.

Order : Tetraphyllidea Carus, 1863

Family : Phyllobothriidae Braun, 1900

Genus : *Anthobothrium* Van. Beneden, 1850

Species : *Anthobothrium blochii* n.sp.

Species : *Anthobothrium puriensis* n.sp.

Species : *Anthobothrium srivastavai* n.sp.

Order : Proteocephalidea Mola, 1928

Family : Proteocephalidae La Rue, 1911

Subfamily : Gangesiinae Mola, 1929

Genus : *Gangesia* Woodland, 1924

Species : *Gangesia chauhani* n.sp.

Family : Monticellidae La Rue, 1911

Subfamily : Zygobothriinae Woodland,1933

Genus : *Nomimoscolex* Woodland,1934

Species : *Nomimoscolex shrotrii* n.sp.

# PART-B

Order : Amphilinidea Poche,1922

Family : Amphilinidae Claus,1879

Genus : *Gigantolina* Poche,1922

Subgenus : *Gigantolina* (*Unilobulata*) n.subg.

Species : *Gigantolina (Unilobulata) raebareliensis* n.subg., n.sp.

(Plate-1 Figs 1-2)

Out of two Fishes, *Mystus tengara*(Ham.) examined at Raebareli one was found infected with single cestode in its intestine. Morphological studies of the cestode revealed them to belong to genus *Gigantolina* Poche, 1922 new subgenus *Unilobulata* n.subg. and new species *Gigantolina (Unilobulata) raebareliensis* n.sp.ofthe family Amphilinidae Claus, 1879 order Amphilinidea Poche, 1922.

## AMENDED DIAGNOSIS OF THE GENUS *GIGANTOLINA* POCHE, 1922

Both ends blunt, body very long, flattened covered with gland cells, testes very numerous in lateral fields, cirrus pouch small, ovary single lobed or bilobed, vagina opens dorsally anterior to cirrus, large seminal receptacle present, descending limb of uterus median, uterine pore ventral at anterior end, eggs lacking polar processes. Parasites of marine as well as fresh water fishes.

*Gigantolina (Unilobulata) raebareliensis* n.subg.,n.sp.

Cestode large sized, unsegmented measures 125.0x0.5-3.0. Scolex muscular not differentiated from rest of the body. Gland cells scattered throughout the body except anterior region. Gland cells measure 0.013-0.029 (0.02) in diameter muscles well developed running posteriorly.

Testes numerous, arranged in two lateral fields exterior to uterine coils measures 0.026 - 0.052 x 0.026 - 0.052 (0.035 x 0.035). Cirrus pouch oval measures 0.156 x 0.208. Seminal vesicles absent. Ovary single lobed, medullary an elongate mass measures 6.7 x 0.15 - 0.78. Vagina post ovarian long coiled tube form a long posterior loop up to the posterior end of body measures 0.052 - 0.13 in diameter. Vitellaria follicular arranged in two rows on the lateral sides of testes measure 0.019 - 0.052 (0.035), extending anterior and posterior to testes. Receptaculum seminis present measures 0.156 - 0.338 x 0.31 - 0.56.

Uterus N-shaped long coiled tube filled with numerous eggs. Uterus opens at anterior end.

Eggs oval to spherical measure 0.026 - 0.126 x 0.026 - 0.126 (0.059 x 0.059).

## DISCUSSION

Schmidt, G.D. 1986 has included only six genera in

the family Amphilinidae Claus, 1879. The present form comes closer to *Gigantolina* Poche, 1922.

The present form differs from *Gigantolina* Poche, 1922 in having elongate single mass of ovary, long loop like vagina without any sphincter.

Thus the proposed new genus differs from all the known genera of the family Amphilinidae Claus, 1879.

In the light of above discussion the species may be provisionally accommodated in the proposed new subgenus.

Host : Mystus tengara (Ham.)

Habitat : Intestine

Locality : Raebareli

Holotype : Post graduate department of Zoology, Bipin Behari College, Jhansi.

KEY TO THE SUBGENERA OF THE GENUS *GIGANTOLINA* POCHE, 1922

Bilobed ovary------------------------------*Gigantolina* n.subg.

Single lobed ovary------------------------*Unilobulata* n.subg.

Order : Caryophyllidea Beneden in Carus, 1863

Family : Lytocestidae Hunter, 1927

Genus : *Monobothrioides* Fuhrmann *et* Baer, 1925.

Species : *Monobothrioides woodlandi*

Mackiewicz and Beverley Burton, 1967

(Plate - 2 Figs.1-4)

Out of four *Notopterus notopterus* (Ham.) examined at Jhansi, one was found infected with twelve cestodes in its intestine. Morphological studies of the cestodes revealed them to belong to the genus *Monobothrioides* Fuhrmann *et* Baer, 1925 of the family Lytocestidae Hunter, 1927 order Caryophyllidea Beneden in Carus, 1863.

Cestodes medium sized measure 5.0-12.0 x 0.15-0.75 (7.51 x 0.47). Scolex oval to round measures 0.58-0.78 x 0.15-0.58 (0.62 x 0.43) with small grooves on the apical region. Neck measures 2.0-5.0 x 0.1-0.2 (3.5 x 0.14).

Testes oval to round, 180-220 in number measures 0.033-0.118 x 0.033-0.118 (0.077 x 0.073). Cirrus pouch median, oval measures 0.29-0.52 x 0.15-0.35 (0.39 x 0.23). Internal and external seminal vesicles absent.

Female genitalia posteriorly situated. Ovary H-shaped measures 0.48-0.88 x 0.32-0.48 (0.61 x 0.38) behind the cirrus pouch. Vitelline follicles oval to round, preovarian measure 0.031-0.081 x 0.031-0.081 (0.042 x 0.042) forming a

complete ring in transverse section. Receptaculum seminis absent.

Genital pores located near cirrus pouch. Male and female genital pores open separately.

Uterus a long coiled tube which extend upto posterior extremity of ovary but never extends beyond the cirrus pouch.

Eggs oval nonoperculate, 0.039-0.078 x 0.039-0.078 (0.053 x 0.053).

## DISCUSSION

A comparison of the present form with all the reported species of the genus *Monobothrioides* Fuhrmann *et* Baer, 1925 reveals its closeness to *Monobothrioides woodlandi* Mackiewicz and Beverley - Burton, 1967 (refer table 1). The only major difference between the two lies in size of worm, presence of long neck and different extension of larger vitellaria which alone do not warrant the erection of a new species for the present form. The present study reveals its wider geographical distribution as it has been first time reported from India.

It is thus concluded that the size of worm in *Monobothrioides woodlandi* Mackiewicz and Beverley Burton, 1967 be considered as 1.6-4.6 x 1.1-1.3. The neck is considered like a constriction. The size of vitellaria be considered as 0.013-0.053 in diameter.

Host : *Notopterus notopterus*

Habitat : Small intestine

Locality : Pahuj Dam, Jhansi

Holotype : Post graduate Department of Zoology,
Bipin Behari College, Jhansi.

TABLE NO. 1

COMPARISON OF THE CHARACTERS OF *MONOBOTHRIOIDES WOODLANDI* MACKIEWICZ AND BEVERLEY-BURTON, 1967 WITH THE PRESENT FORM

| | *Monobothrioides woodlandi* Mackiewicz and Beverley-Burton, 1967 | *Monobothrioides woodlandi* Present form |
|---|---|---|
| Size | 1.6-4.6 x 1.1-1.3 | 5.0-12.0 x 0.15-0.75 |
| Neck | only a compression separates the scolex from whole body. | long neck 2.0-5.0 x 0.1-0.2 |
| TESTES | | |
| Number | 177-203 | 180-220 |
| Size | 0.056-0.096 | 0.33-0.118 x 0.33-0.118 |
| **VITELLINE** FOLLICLES | | |
| Size. | 0.013-0.053 | 0.031-0.081 x 0.031-0.081 |
| Extension | ovary to base of scolex | ovary to base of neck |
| Ovary | H-shaped | H-shaped |
| Egg (Dia) | 0.041-0.062 | 0.039-0.078 |

Order : Caryophyllidea Beneden in Carus, 1863

Family : Lytocestidae Hunter, 1927

Genus : *Bilobulata* n.g.

species : *Bilobulata georgievi* n.g.,n.sp.

( Plate -3, figs.1-4 )

Two, out of four fishes, *Clarius batrachus* (Linn.) were caught at Barua sagar, district Jhansi, which yielded eight cestodes in their intestines. The morphological studies of the cestodes revealed them to belong to a new genus *Bilobulata* n.g. and a new species *Bilobulata georgievi* n.g.,n.sp. of the family Lytocestidae Hunter 1927, order Caryophyllidea Beneden in Carus, 1863.

## GENERIC DIAGONOSIS

Worm medium sized. Smooth, flat, blunt scolex. Gonopores separate. Cirrus pouch well developed. External seminal vesicle and seminal receptacle absent. Bilobed ovary posteriorly located, lateral lobes of ovary cortical while isthmus medullary. Pre and post testicular vitelline follicles crescent shaped in cross section, post ovarian follicles absent. Single circle of inner longitudinal muscle present. Uterus extends posterior to ovary. Eggs oval, nonoperculate. Parasites of siluroid fishes.

---

Abstract published in Proc. 79th Ind. Sc. Cong. Part-III section IX No. 72:47, 1992.

*Bilobulata georgievi* n.g., n.sp.

Cestodes measure 5.0-11.0 in length and 2.25 in maximum width. Scolex smooth, blunt well differentiated by a constriction, without any cushion or groove, measures 1.0-1.5x0.19-1.0 (1.25x0.75).

Testes innumerable in number, oval to round in medullary parenchyma anterior to cirrus pouch measures 0.039-0.098x0.039-0.098 (0.062x0.075). Cirrus pouch oval, median measures 0.352-0.59x0.184-0.593 (0.411-0.345). Internal and external seminal vesicles absent.

Female genitalia posteriorly located, ovary bilobed measures 0.157-0.580x0.687-1.179 (0.326x0.907) behind the cirrus pouch. Lateral lobes of ovary situated in cortex and isthmus in medullary region. Vitellaria cortical, innumerable measures 0.019-0.068x0.019-0.068 (0.033x0.039) extending even beyond the anterior and posterior to the testicular zone forming crescent in transverse section. Receptaculum seminis absent.

Uterus nonglandular, coiled, medullary, situated posterior and anterior to the ovarian isthmus. Uterine coils number 10-15 measuring 0.13- 0.6 (0.4) in diameter.

Eggs oval, nonoperculate measure 0.013-0.039x 0.026-0.058 (0.024 x 0.037)

Genital pores located near the cirrus pouch. Male and female genital pores open separately.

## DISCUSSION

Schmidt, G.D.1986 has included only 15 genera in the family Lytocestidae Hunter, 1927. The present form comes closer to the genus *Stocksia* Woodland, 1937 and *Crescentovitus* Murhar, 1964.

The present form differs from *Stocksia* Woodland, 1937 in having flat, blunt scolex devoid of groove or cushion, separate male and female genital pores, bilobed ovary, single circle of inner longitudinal muscle, extension of vitelline follicles and uterus. From *Crescentovitus* Murhar, 1964 it differs in having smooth, flat, blunt scolex, bilobed ovary and extension of vitelline follicles.

Thus the proposed new genus *Bilobulata* n.g. differs from all the known genera of the family Lytocestidae.

In the light of above discussion the species *Bilobulata georgievi* n.g., n.sp. may be provisionally accommodated in the proposed new genus *Bilobulata* n.g.

The species is named after a renouned Helminthologist prof. (Dr.) B.B. Georgiev of Bulgaria.

Host : *Clarius batrachus* (Linn.)

Habitat: Intestine

Locality: Barua sagar, Jhansi

Holotype: Post graduate Department of Zoology,
Bipin Behari College, Jhansi.

Key to the various genera of the family Lytocestidae Hunter, 1927

1. Postovarian vitellaria present --------------------2

postovarian vitellaria absent----------------------8

2. Cirrus and uterovaginal canal open separately-------3

One gonopore present--------------------------------4

3. Gonopore in middle third of body--------------------- *Markevitschia* Kulakowskaya *et* Ackmorov, 1965

Gonopore farther posterior------*Lucknowia* Gupta, 1961

4. Ovary indistinctly bilobate-----*Lytocestoides* Baylis, 1928

Ovary shaped like an H or an inverted A-------------5

5. Ovary shaped like an inverted A---------------------- ----------------------*Caryophyllaeides* Nybelin, 1922

Ovary H-shaped-------------------------------------6

6. Scolex broad, flat, fimbriate, not separated from body by a well defined constricted neck------------- ------------------------------------*Khawia* Hsu, 1935

Scolex not fimbriate---------------------------------7

7. Scolex bell shaped, with prominent collar around base and with apical funnel------------------------------- -------------*Caryoaustralus* Mackiewicz *et* Blair, 1980

Scolex conical,small narrower than body and separated from it by well defined constricted neck-------------

---------------------*Atractolytocestus* Anthony, 1958

8. Ovarian lobes entirely medullary ------------------9

Ovarian lobes partly cortical----------------------11

9. Scolex with terminal sucker--------------------------

----------------------------*Djombangia* Bovien, 1926

Scolex lacking terminal sucker---------------------10

10. Scolex undifferentiated; uterus extending far forward from cirrus---------------*Notolytocestus* Johnston *et* Muirhead, 1950

Scolex dome shaped;uterus not extending anterior to cirrus------------*Thalophyllaeus* Mackiewicz *et* Blair 1980

11. Scolex differentiated -----------------------------12

Scolex undifferentiated----------------------------14

12. Vitellaria surrounding *testes*---------*Monobothrioides* Fuhrmann *et* Baer, 1925

Vitellaria lateral crescent shape in cross section -------------------------------------------------13

13. Ovary inverted A-shaped----------------*Crescentovitus* Murhar, 1964

Ovary H shaped----------------*Stocksia* Woodland, 1937

Ovary bilobed------------------------*Bilobulata* n.g.

14. Vitellaria lateral------------*Bovienia* Fuhrmann, 1931

Vitellaria surrounding testes---*Lytocestus* Cohn, 1908

Order- Caryophyllidea Beneden in Carus, 1863.

Family- Capingentidae Hunter, 1930.

Genus- *Mystoides* n.g.

Species- *Mystoides bundelkhandensis* n.g., n.sp.

(plate- 4, Figs.1-3)

One out of three *Mystus aor* (Ham.) examined at Jhansi, yielded single cestode in its intestine. Morphological studies of the cestode revealed them to belong to a new genus *Mystoides* n.g. and a new species *Mystoides bundelkhandensis* n.g. n.sp.of the family Capingentidae Hunter, 1930 order Caryophyllidea Beneden in Carus, 1863.

GENERIC DIAGNOSIS

Worm large sized. Smooth, flat, blunt scolex, neck like a constriction, common genital atrium with male and female pore, cirrus pouch well developed, seminal vesicles and receptaculum seminis absent, testes in broad median field anterior to ovary, ovary U shaped posteriorly located, lateral lobes of ovary in cortex,vitellaria extending beyond anterior and posterior limit of testes, no post ovarian follicles, uterus not extending anterior to cirrus pouch,eggs spherical, nonoperculate. Parasites of siluroid fishes.

*Mystoides bundelkhandensis* n.g., n.sp.

Cestode large sized, unsegmented measures 37.2x1.6.

Scolex smooth, blunt well differentiated by a constriction, without any cushion or groove, measures 1.601 x 0.578. Testes numerous, oval to round measures 0.091-0.176 x 0.091-0.176 (0.132x0.122) in medullary parenchyma anterior to cirrus pouch. Cirrus pouch oval, median measures 0.774 x 0.529. Internal and external seminal vesicles absent.

Female genitalia posteriorly situated, ovary U shaped with unequal limbs measures 4.19-4.56 x 1.37 behind the cirrus pouch. Part of lateral lobes of ovary situated in cortex. Vitellaria innumerable measures 0.026-0.137 x 0.026-0.137 (0.078 x 0.078) extending beyond the anterior and posterior to the testicular region. Receptaculum seminis absent.

Uterus long coiled tube filled with numerous eggs, extends anterior to ovarian lobes behind the cirrs pouch .

Common genital atrium with male and female pore situated at the base of cirrus pouch.

Eggs spherical, nonoperculate measure 0.026-0.039x 0.026-0.039 (0.032 x 0.032).

Excretory tube measures 0.13 in length.

# D I S C U S S I O N

Schmidt, G.D.,1986 has included only 8 genera in family Capingentidae Hunter, 1930. The present form comes closer to the genus *Spartoides* Hunter, 1929.

The present form differs from *Spartoides* Hunter, 1929 in having flat, blunt scolex devoide of any loculi, common genital atrium, absence of external seminal vesicle, uterus not extending anterior to cirrus pouch and vitellaria extending beyond the anterior and posterior to testicular zone.

Thus the proposed new genus *Mystoides* n.g. differ from all the known genera of the family Capingentidae Hunter, 1930.

In the light of above discussion the species *Mystoides bundelkhandensis* n.g., n.sp. may be provisionally accommodated in the proposed new genus *Mystoides* n.g.

Host : *Mystus aor* (Ham.)

Habitat : Intestine

Locality : Jhansi

Holotype : Post graduate Department of zoology,

Bipin Behari College, Jhansi.

KEY TO THE VARIOUS GENERA OF THE FAMILY CAPINGENTIDAE

1. Postovarian median vitellaria present------------------------2

   Postovarian median vitellaria absent-------------------------6

2. Uterine coils extend anterior to cirrus pouch,

   scolex with two large bothria-----------*Capingens* Hunter, 1927

   Uterine coils not extending anterior to cirrus pouch,

   scolex lacking bothria-----------------------------------3

3. Ovary shaped like an inverted A------*Adenoscolex* Fotedar, 1958

   Ovary not as above--------------------------------------4

4. Ovary dumb bell-shaped, scolex quite reduced, neck absent-----

   --------------------------------*Breviscolex* Kulakowskaya, 1962

   Ovary otherwise, scolex well developed, neck present---------5

5. Ovary H shaped---------------------*Edlintonia* Mackiewicz, 1970

   Ovary band-shaped------------------*Capingentoides* Gupta, 1961

6. Ovary U shaped, uterine coils extending anterior to cirrus

   pouch--------------------------------*Spartoides* Hunter, 1929

   Ovary U shaped, uterine coils not extending anterior to cirrus

   pouch----------------------------------------*Mystoides* n.g.

   Ovary not U shaped, uterine coils not extending anterior to

   cirrus pouch-------------------------------------------7

7. Neck absent, ovary H shaped------*Pseudolytocestus* Hunter, 1929

   Very long neck present, ovary band shaped--------------------

   -----------------------------*Pseudocaryophyllaeus* Gupta, 1961

Order : Caryophyllidea Beneden in Carus, 1863

Family : Capingentidae Hunter, 1930

Genus : *Pseudolytocestus* Hunter, 1929

Species : *Pseudolytocestus dayali* n.sp.

(Plate-5, figs- 1-4)

Out of three *Mystus aor* (Ham.) examined at Jhansi, only one was found infected with single cestode in its intestine. Morphological studies of the cestode revealed them to belong to the genus *Pseudolytocestus* Hunter, 1929 of the family Capingentidae Hunter, 1930 and order Caryophyllidea Beneden in Carus, 1863.

Cestode measures 14.0x1.0. Scolex round measures 0.728x0.728. Neck absent.

Testes numerous oval to round measures 0.058-0.158x0.058-0.158 (0.108x0.108), scattered in meadullary parenchyma anterior to cirrus pouch. Vas deferens a loosely convoluted median tube passing anteriorly. Cirrus pouch oval, median measures 0.546x0.402. Internal and external seminal vesicles absent.

Female genitalia posteriorly located. Ovary H shaped measures 1.306x0.784. Vitellaria innumerable oval to round measures 0.026-0.104x0.026-0.104 (0.058x0.058) extending beyond the anterior and posterior testicular zone. Post ovarian follicles absent.

Genital apertures separate situated at the posterior part of body.

Uterus tube like structure filled with numerous eggs.

Eggs oval to round, nonoperculate measure 0.019-0.029x0.019-0.029 (0.023x0.023).

## D I S C U S S I O N

The present form comes closer to *Pseudolytocestus clariae* Gupta, 1961 and *Pseudolytocestus thapari* Gupta and Parmar, 1990.

From *Pseudolytocestus clariae* Gupta, 1961 it differs in having smaller worm, smaller scolex, absence of neck, smaller cirrus pouch, larger ovary, smaller vitelline follicles, absence of post ovarian follicles and smaller eggs. From *Pseudolytocestus thapari* Gupta and Parmar, 1990 it differs in having larger but narrower worm, smaller scolex, absence of neck, smaller cirrus pouch, smaller ovary and smaller eggs.

In the light of above discussion it may be proposed to accommodate the present form as a new species, *Pseudolytocestus dayali* n.sp.

The species is named after the eminent Indian Helminthologist late Dr. H.D.Srivastava former Head of Parasitology department I.V.R.I., Izatnagar (U.P.), India.

Host : *Mystus aor* (Ham.)

Habitat : Small intestine

Locality : Pahuj dam, Jhansi

Holotype : Post graduate Department of Zoology,

Bipin Behari College, Jhansi

TABLE NO. 2

COMPARISON OF THE CHARACTERS OF THE SPECIES CLOSER TO

*PSEUDOLYTOCESTUS DAYALI* n.sp.

| | *P.clariae* Gupta,1961 | *P.thapari* Gupta and Parmar,1990 | *P.dayali* n.sp. |
|---|---|---|---|
| Size | 15.32x4.02 | 9.04-9.08x1.77-1.82 | 14.0x1.0 |
| Scolex | 1.78x0.8 | 1.72-1.75x0.98-1.00 | 0.728x0.728 |
| Neck | Like a constriction | Like a constriction | Absent |
| Cirrus pouch | 0.9x0.6 | 0.25-0.27x0.15-0.16 | 0.54x0.402 |
| Ovary | H shaped<br>Left wing- 1.12x0.4<br>Right wing- 1.06x0.6 | 0.25-0.27x0.15-0.16 | 1.306x0.784 |
| Vitelline follicles | | | |
| Size | 0.11-0.2x0.11-0.17 | 0.67-0.8x0.04-0.05 | 0.026-0.104x 0.026-0.104 |
| Extention | Post ovarian follicles present | Post ovarian follicles absent | Post ovarian follicles absent |
| Eggs. | 0.04-0.043x0.03-0.04 | 0.032-0.034x0.18-0.20 | 0.019-0.029x 0.019-0.029 |

Order : Caryophyllidea Beneden in Carus, 1863

Family : Capingentidae Hunter, 1930

Genus : *Pseudolytocestus* Hunter, 1929

Species : *Pseudolytocestus pandei* n.sp.

(Plate - 6, Figs 1-3)

Out of ten *Clarius batrachus* (Linn.) examined at Jhansi, only three were found infected with fifteen cestodes in their intestines. Morphological studies of the cestode revealed them to belong to the genus *Pseudolytocestus* Hunter, 1929 of the family *Capingentidae* Hunter, 1930 and order Caryophyllidea Beneden in Carus, 1863.

Cestodes measure 5.0-17.0x0.392-0.784 (10.5x0.532). Scolex oval to round measures 1.17-1.37 x 0.212-0.628 (1.2x0.458). Neck prominent.

Testes numerous,oval to round measures 0.039-0.098 x 0.039-0.098 (0.056 x 0.056) scattered in medullary parenchyma anterior to cirrus pouch till the neck level. Vas deferens a loosely convoluted median tube passing anteriorly. Cirrus pouch oval,median measures 0.238-0.352 x 0.117-0.196 (0.25 x 0.145).

Female genitalia posteriorly located. ovary H shaped measures 0.392-0.548 x 0.392-0.548 (0.422 x 0.452). Most part of the ovary medullary, left lobe is larger than right lobe. Vitellaria innumerable, oval to round measure 0.013-0.052x

0.013-0.052 (0.028 x 0.032) extending beyond the anterior and posterior testicular zone. Post ovarian follicles absent.

Genital apertures come very near to each other situated at posterior end of the body.

Uterus a loosely packed convoluted tube.

## D I S C U S S I O N

The present form comes closer to *Pseudolytocestus clariae* Gupta, 1961 and *Pseudolytocestus thapari* Gupta and Parmar, 1990.

From *Pseudolytocestus clariae* Gupta, 1961 it differs in having narrower worm, smaller scolex, presence of long neck, smaller testes, smaller vitellaria, smaller cirrus pouch and smaller ovary. From *Pseudolytocestus thapari* Gupta and Parmar, 1990 it differs in having narrower worm, smaller scolex, presence of long neck, smaller testes, smaller vitellaria, smaller cirrus pouch and larger ovary with enlarged left wing.

In the light of above discussion it may be proposed to accommodate the present form as a new species *Pseudolytocestus pandei* n.sp.

The species is named after the eminent Indian Helminthologist, Prof (Dr.) K.C. Pandey, Head of Zoology Department, Lucknow University, Lucknow.

Host : *Clarius batrachus* (Linn.)

Habitat : Coelom and small intestine

Locality : Barua sagar, Jhansi

Holotype : Post graduate Department of Zoology,

Bipin Behari College, Jhansi.

TABLE NO. 3

COMPARISON OF THE CHARRCTERS OF THE SPECIES CLOSER TO

*PSEUDOLYTOCESTUS PANDEI* n.sp.

| | *P.clariae* Gupta, 1961 | *P.thapari* Gupta & Parmar, 1990 | *P.pandei* n.sp. |
|---|---|---|---|
| Size | 15.32x4.02 | 9.04-9.08x1.77-1.82 | 5.0-17.0x0.392-0.784 |
| Scolex | 1.78x0.8 | 1.72-1.75x0.98-1.00 | 1.17-1.37x0.212-0.628 |
| Neck | like a constriction | like a constriction | long neck present |
| Testes | 0.11-0.18x 0.075-0.12 | 0.10-0.11x0.07-0.09 | 0.039-0.098x0.039-0.098 |
| Cirrus pouch | 0.9x0.6 | 0.58-0.60x0.51-0.52 | 0.238-0.352x0.117-0.196 |
| Ovary | H-shaped left wing- 1.12x0.4 right wing 1.06x0.6 | 0.25-0.27x0.15-0.16 | H-shaped left wing larger than right. 0.392-0.548x0.392-0.548 |
| Vitelline follicles | | | |
| Size | 0.11-0.2x 0.11-0.17 | 0.067-0.08x0.04-0.05 | 0.013-0.052x0.013-0.052 |
| extension | post ovarian follicles present. | post ovarian follicles absent. | post ovarian follicles absent. |

TABLE NO. 4

COMPARISON OF THE CHARRCTERS OF *PSEUDOLYTOCESTUS DAYALI* n.sp. AND *PSEUDOLYTOCESTUS PANDEI* n.sp.

| | *P.dayali* n.sp. | *P.pandei* n.sp. |
|---|---|---|
| Scolex | 6.728x0.728 | 1.17-1.37x0.212-0.628 |
| Neck | absent | Long neck present |
| Cirrus pouch | 0.54x0.402 | 0.238-0.352x0.117-0.196 |
| Ovary | 1.306x0.784 | H.shaped left wing larger than right.<br>0.392-0.548x0.392-0.548 |

Order : Caryophyllidea Beneden in Carus,1863

Family : Capingentidae Hunter,1930

Genus : *Pseudoadenoscolex* n.g.

Species : *Pseudoadenoscolex fossilis* n.g.,n.sp.

(Plate - 7 Figs.1 - 3)

One out of six *Heteropneustes fossilis* (Bloch.) examined at Jhansi, yielded five cestodes in its intestine. Morphological studies of the cestodes revealed them to belong to a new genus *Pseudoadenoscolex* n.g. and a new species *Pseudoadenoscolex fossilis* n.g., n.sp. of the family Capingentidae Hunter, 1930; order Caryophyllidea Beneden in Carus, 1863.

GENERIC DIAGNOSIS

Worm large sized, scolex not differentiated from rest of the body, neck absent, gonopores separate, cirrus pouch well developed, internal seminal vesicle bell shaped, external seminal vesicle and receptaculum seminis absent, testes in broad median field anterior to cirrus pouch, ovary inverted A-shaped posteriorly located, laterel lobes of ovary in cortex, vitellaria extending beyond anterior and posterior to the testes, no post-ovarian vitellaria, uterus not extending anterior to cirrus pouch, eggs spherical, nonoperculate. Parasites of siluroid fishes.

*Pseudoadenoscolex fossilis* n.g., n.sp.

Cestodes large sized, unsegmented measures

27.0-40.0x0.05-2.5(32.5x1.5). Scolex undifferentiated.

Testes numerous, oval to round in medullary parenchyma anterior to cirrus pouch. Testes measures 0.098-0.221x0.098-0.221 (0.17x0.17). Cirrus pouch oval, median measure 0.068-0.168x0.058-0.078 (0.117x0.067). Internal seminal vesicle bell shaped measures 0.196-0.39x0.196-0.39 (0.23x0.23). External seminal vesicle absent.

Female genitalia posteriorly located. Ovary inverted A-shaped measures 5.88-7.46x1.17-2.16 (6.12x1.98), some part of lateral lobes of ovary situated in cortex. Vitellaria innumerable, measure 0.078-0.19x0.078-0.19 (0.12x0.12) extending beyond the anterior and posterior testicular region. Receptaculum seminis absent.

Uterus long coiled tube, extends anterior to ovarian lobes behind cirrus pouch filled with numerous eggs.

Gonopores separate situated at the base of cirrus pouch.

Eggs oval, nonoperculate measure 0.01-0.05 x 0.01-0.05 (0.03x0.03).

## D I S C U S S I O N

Schmidt,G.D., 1986 has included only 8 genera in family Capingentidae Hunter, 1930. The present form comes closer to the genus *Pseudolytocestus* Hunter, 1929 and *Pseudocaryophylleus* Gupta, 1961.

The present form differs from *Pseudolytocestus* Hunter, 1929 in having bell shaped internal seminal vesicle and inverted A-shaped ovary. From *Pseudocaryophyllaeus* Gupta, 1961 it differs in having absence of scolex, absence of neck, bell shaped internal seminal vesicle and inverted A-shaped ovary.

Thus the proposed new genus *Pseudoadenoscolex* n.g. differs from all the known genera of the family Capingentidae Hunter, 1930.

In the light of above discussion the species *Pseudoadenoscolex fossilis* n.g., n.sp. may be provisionally accommodated in the proposed new genus.

Host : *Heteropneustes fossilis* (Bloch.)

Habitat : Intestine

Locality : Jhansi

Holotype : Post graduate Department of Zoology,
Bipin Behari College, Jhansi.

KEY TO THE VARIOUS GENERA OF THE FAMILY CAPINGENTIDAE HUNTER, 1930

1. Postovarian median vitellaria present------------------------2

   Postovarian median vitellaria absent-------------------------6

2. Uterine coils extends anterior to cirrus pouch,scolex with two large bothria---------------------------*Capingens* Hunter, 1927

   Uterine coils not extending anterior to cirrus pouch, scolex lacking bothria----------------------------------------------3

3. Ovary shaped like an inverted A------*Adenoscolex* Fotedar, 1958

   Ovary not as above-------------------------------------------4

4. Ovary dumb bell shaped, scolex quite reduced, neck absent --------------------------------*Breviscolex* Kulakowskaya, 1962

   Ovary otherwise, scolex well developed, neck present---------5

5. Ovary H-shaped---------------------*Edlintonia* Mackiewicz, 1970

   Ovary band shaped-------------------*Capingentoides* Gupta, 1961

6. Ovary U-Shaped, uterine coils extending anterior to cirrus pouch----------------------------------*Spartoides* Hunter, 1929

   Ovary not U-shaped, uterine coils not extending anterior to cirrus pouch-------------------------------------------------7

7. Neck absent, ovary H-shaped----------------*Pseudolytocestus* Hunter, 1929

   Neck absent, ovary inverted A shaped----*Pseudoadenoscolex* n.g.

   Very long neck present ovary band shaped------------------ ------------------------------*Pseudocaryophylleus* Gupta, 1961

Order : Pseudophyllidea Carus, 1863

Family : Ptychobothriidae Luhe, 1902

Genus : *Circumoncobothrium* Shinde, 1968

Species : *Circumoncobothrium capoori* n.sp.

(Plate 8, Figs. 1-5)

Two, out of five fishes *Mastacembelus armatus* (Lacepede) were examined at Pahuj dam, Jhansi, which yielded five cestodes in their intestines.Morphological studies of the cestodes revealed them to belong to the genus *Circumoncobothrium* Shinde, 1968 of the family Ptychobothriidae Luhe 1902, order Pseudophyllidea Carus, 1863.

Cestodes large sized measure 78.2-100.8x1.0-1.3 (85.2x1.1).

Scolex well developed narrow anteriorly and broad posteriorly measures 1.01-1.41x0.118-0.784 (1.2x0.42). Bothria sac like measures 0.78-1.378x0.001-0.294 (0.95x0.125). Hooks 32-40 in number of various size in single crown at the apex of bothria measure 0.013-0.052 (0.028) in length. Neck distinct measures 0.39-0.48x0.196-0.235 (0.42x0.205). Proglottids numerous in number broader than long.

Immature proglottids measure 0.098-0.137 x 0.313-0.823 (0.115x0.615), mature proglottids measure 0.176-0.394 x0.98-1.29 (0.25x1.15) and gravid proglottids measure 0.274-0.49 x 1.17-1.36 (0.35x1.25).

Tests oval to round numerous in number, scattered throughout the proglottids measure 0.019-0.058x0.019-0.058 (0.032x 0.032) which never cross the ventral longitudinal excretory canal.

Ovary centrally located, bilobed, dumb bell shaped with a long isthmus. Both the lobes of the ovary compact with globular acini ovary measures 0.026-0.156x0.274-0.49 (0.092x0.32). Vitellaria lateraly located measures 0.013-0.026x0.013-0.026 (0.018x0.018).

Genital opening at the centre of ovary. Uterus preovarian located in the middle of the proglottid filled with eggs.

Eggs oval, nonoperculate measure 0.026-0.058x 0.026-0.058 (0.035x0.032).

Ventral longitudinal excretory canal measures 0.006-0.013 (0.008) in diameter.

## D I S C U S S I O N

The present form comes closer to *Circumoncobothrium ophiocephali* Shinde, 1968 and *Circumoncobothrium shindei* Shinde and Chincholikar, 1977.

The present form differs from *Circumoncobothrium ophiocephali* Shinde, 1968 in having larger but narrower worm, larger scolex, larger but narrower bothria, smaller number of hooks, narrower neck and broader mature proglottid. From *Circumoncobothrium shindei* Shinde and Chincholikar, 1977 it

differs in having smaller but broader scolex, smaller but broader bothria, smaller number of hooks, smaller mature proglottids, smaller gravid proglottids and larger ovary.

In the light of above discussion it may be proposed to accommodate the present form as a new species *Circumoncobothrium capoori* n.sp.

The species is named after the eminent Indian cestodologist Dr. V.N.Capoor retired reader of Zoology Department, University of Allahabad, Allahabad.

Host : *Mastacembelus armatus* (Lacepede.)

Habitat : Intestine

Locality : Jhansi

Holotype : Post graduate Department of Zoology, Bipin Behari College, Jhansi.

TABLE NO. 5

COMPARISON OF THE CHARACTERS OF THE SPECIES CLOSER TO

*CIRCUMONCOBOTHRIUM CAPOORI* n.sp.

| | *C.Ophiocephali* Shinde, 1968 | *C. Shindei* Shinde and Chincholikar, 1977 | *C.capoori* n.sp. |
|---|---|---|---|
| Size | 30.0-32.0x1.75-1.83 | - | 78.2-100.8x1.0-1.31 |
| Scolex | 0.81x0.51 | 1.56x0.43 | 1.01-1.41x0.118-0.784 |
| Bothria | 0.69x0.41 | Left-1.45x0.55<br>Right-1.53x0.74 | 0.78-1.378x0.001-0.294 |
| Number of hooks | 80 | 49 | 32-40 |
| Neck width | 0.33 | Present | 0.196-0.235 |
| Mature proglottid | 0.34x1.83 | 0.40x1.79 | 0.176-0.394x0.98-1.29 |
| Gravid proglottid | - | 0.57x1.22 | 0.274-0.49x1.17-1.36 |
| Ovary | 0.36-0.40 Width | Length -0.44<br>Isthamus- 0.21<br>Lobes-0.12-0.13 x0.13-0.12 | 0.026-0.156x0.274-0.49 |

Order : Pseudophyllidea Carus, 1963

Family : Ptychobothriidae Luhe, 1902

Genus : *Senga* Dollfus, 1934

Species : *Senga jhansiensis* n.sp.

(Plate - 9, Figs. 1 - 4)

Two out of five fishes, *Mastacembellus armatus* (Lacepede) examined at Jhansi, yielded five cestodes in their intestines. The morphological studies of the cestodes revealed them to belong to the genus *Senga* Dollfus, 1934 of the family Ptychobothriidae Luhe 1902, order Pseudophyllidea Carus, 1863.

Cestodes large measure 110.0-125.0x0.98-1.23 (118.0x1.02). Scolex oval, well developed, narrow anteriorly and broader posteriorly measures 0.98-1.4x0.23-0.61 (1.2x0.43). Two sac like bothria measures 1.11-1.23x0.001-0.32 (1.18x0.25). Rostellum with 28-32 rostellar hooks in two semicircles. Smaller hooks at the lateral sides of semicircles. Neck distinct measures 2.3-4.2x0.19-0.26 (3.5x0.24).

Proglottids craspedote, broader than long. Immature proglottids measure 0.098-0.24 x 0.313-0.68 (0.18x0.428), mature proglottids 0.26-0.49x0.78-1.23 (0.35x0.98) and gravid proglottids 0.39-0.58x0.78-1.23 (0.48x0.98).

Testes oval to round numerous in number measure 0.013-0.058x0.013-0.058 (0.035x0.035), scattered throughout the proglottids evenly.

Female genitalia posteriorly located. Ovary bilobed, with a long isthmus measures 0.013-0.21x0.196-0.39 (0.15x0.28). Vitellaria innumerable, cortical measures 0.011-0.039 x0.011-0.039, disposed in two lateral bands.

Genital pore medial in the centre of segment. Uterus in the middle of segment anterior to ovary filled with eggs.

Eggs oval, nonoperculate measure 0.0196-0.058x 0.0196-0.058 (0.028x0.028).

DISCUSSION

The present form comes closer to *Senga punctati* Gupta and Sinha 1980, *Senga mastacembali* Gupta and Sinha, 1980 and *Senga indica* Gupta and Parmar, 1985.

The present form differs from *Senga punctati* Gupta and Sinha, 1980 in having smaller worms, larger scolex, larger bothria, presence of neck, wider than long immature proglottids, largertestes and largerovary. From *Senga mastacembali* Gupta and Sinha, 1980 it differs in having smaller worm, largerscolex, larger bothria, smaller number of apical hooks, presence of neck, longer mature and gravid proglottids and wider ovary. From *Senga indica* Gupta and Parmar 1985 differs in having smaller worm, longer scolex, longer bothria, larger number of apical hooks, presence of neck and wider ovary.

In the light of above discussion the species *Senga jhansiensis* n.sp. may be accommodated as a new species.

Host : *Mastacembellus armatus* (Lacepede)

Habitat : Intestine

Locality : Jhansi

Hololype : Postgraduate Department of Zoology,
Bipin Behari College, Jhansi.

## TABLE NO. 6

COMPARISON OF THE CHARACTERS OF THE SPECIES CLOSER TO *SENGA JHANSIENSIS* n.sp.

| | *S.punctati* Gupta and Sinha, 1980 | *S.mastacembali* Gupta and Sinha, 1980 | *S.indica* Gupta and Parmar, 1985 | *S.jhansiensis* n.sp. |
|---|---|---|---|---|
| Size | 150.0-180.0x 1.20-1.49 | 180.0-200.0x 1.2-1.38 | 176.0x1.32 | 110.0-125.0 x0.98-1.23 |
| Scolex | 0.76-0.78 | 0.92-0.99 | 0.78x0.62 | 0.98-1.4x 0.23-0.61 |
| Bothria | 0.55-0.58 | 0.79-0.80 | 0.62 | 1.11-1.23x 0.001-0.32 |
| Number of hooks. | 28-30 | 30-36 | 36 | 28-32 |
| Neck | absent | absent | absent | present |
| Immature proglottid | Longer than wide | - | - | Wider than long |
| Mature proglottid. | 1.42-1.46x 0.062 -0.64 | 0.235-0.23 x0.85-0.89 | 1.86x0.44 | 0.26-0.49x 0.78-1.23 |
| Gravid proglottid. | 1.21-1.31x 0.56-0.60 | 0.293-0.310x 0.89-0.895 | 1.58x0.26 | 0.39-0.58x 0.78-1.23 |
| Ovary | 0.17-0.19x 0.05-0.055 | 0.06-0.07x 0.05-0.055 | 0.18x0.16 | 0.013-0.21x 0.196-0.39 |

Order - Tetraphyllidea Carus, 1863

Family - Phyllobothriidae Braun, 1900

Genus - *Anthobothrium* Van Beneden, 1850

Species - *Anthobothrium blochii* n.sp.

(Plate-10, Figs.1-3)

Out of four hammer headed shark,*Zygaena* blochii (Cuvier) examined at Puri (Orissa), one was found infected with eight cestodes in its intestine. Morphological studies of the cestodes revealed them to belong to the genus *Anthobothriun* Van Beneden, 1850 of the family phyllobothriidae Braun, 1900; Order Tetraphyllidea Carus, 1863.

Incomplete worm measure 3.0-7.0x0.058-0.644 (4.5x0.28). Scolex oval to round measures 0.078-0.143x0.23-0.34 (0.11x0.27). Bothridia cup shaped, pedunculate, unarmed and nonloculated measures 0.036-0.078x0.12-0.16 (0.063x0.148).

Neck and proglottids not covered with spines. Neck measures 0.0196-2.136x0.019-0.098 (1.29x0.05). Strobilae contain only 30-60 proglottids. Immature proglottids broader than long measure 0.058-0.117x0.058-0.196 (0.07x0.16); mature proglottids longer than broad measure 0.294-0.588x0.121-0.392 (0.392x0.274) and gravid proglottids longer than broad, measure 0.732-1.842x 0.244-0.646 (1.254x0.509).

Testes oval to spherical disposed in many lateral

bands, anterior to female genitalia. Testes 40-115 in number measure 0.01-0.117x0.01-0.117 (0.08x0.08). Cirrus pouch oval to spherical measure 0.039-0.217x0.039-0.215 (0.163x0.152) may extend to the middle of proglottid.Cirrus unarmed. Internal and external seminal vesicles absent.

Female genitalia posteriorly situated. Ovary U-Shaped measures 0.039-0.33x0.117-0.33 (0.274x0.284). Vitelline follicles distributed in two lateral bands measure 0.002-0.019x0.002-0.019 (0.006-0.006). Vagina measure 0.006-0.052 (0.03) in diameter opens anterior to cirrus pouch in the genital atrium. Receptaculum seminis oval to round measures 0.039-0.235x 0.019-0.158 (0.098x0.063). Mehlis gland absent.

Genital atrium measures 0.006-0.058x0.016-0.106 (0.030-0.058) deep and wide respectively. Genital openings irregularly alternating located anterior half of the proglottid margin.

Eggs oval measure 0.01-0.039x0.019-0.039 (0.022x 0.025).

## D I S C U S S I O N

The present form comes closer to *Anthobothrium mandube* Woodland, 1935 and *Anthobothrium veravalensis* Shinde, Jadhav and Mohekar,1981.

The present form differs from *Anthobothrium mandube* Woodland, 1935 in having smaller worms, wider scolex,

nonloculated pedunculate bothridia, lesser number of testes, extension of cirrus pouch and shape of ovary. From *Anthobothrium veravalensis* Shinde, Jadhav and Mohekar, 1981 it differs in having smaller scolex, pedunculate bothridia, lesser number of proglottids,smaller mature proglottids, narrower ovary and presence of post ovarian vitelline follicles.

In the light of above discussion the present form may be accommodated as a new species, *Anthobothrium blochii* n.sp.

Host : *Zygaena blochii* (Cuvier)

Habitat : Intestine

Locality : Puri (Orissa)

Holotype : Postgraduate Department of Zoology,
Bipin Behari College, Jhansi.

TABLE NO. 7

COMPARISON OF THE CHARACTERS OF THE SPECIES COMES CLOSER TO THE *ANTHOBOTHRIUM BLOCHII* n.sp.

| | *A.mandube* Woodland, 1935 | *A.veravalensis* Shinde, Jadhav and Mohekar,1981 | A. blochii n.sp. |
|---|---|---|---|
| Size | 45.0x2.0 | - | 3.0-7.0x0.058-0.644 |
| Scolex | 0.18-0.21x 0.18-0.24 | 0.43x0.46 | 0.078-0.143x0.23-0.34 |
| Bothridia | Sessile, loculated | Shallow, Noncrenulated cusps. | Pedunculate |
| Number of proglottids | - | 90 | 30-60 |
| Mature proglottid. | - | 2.07x0.50 | 0.294-0.588x0.121-0.392 |
| Number of testes. | 100-150 | upto 110 | 40-115 |
| Extension of cirrus pouch. | Over one fifth of proglottid width. | - | May extend upto middle of proglottid width. |

continue

| | | | |
|---|---|---|---|
| O Shape | Unilamilar | U-shaped | U-shaped |
| V | strip like | | |
| A | bilobed. | | |
| R Size | - | 0.33x0. 37 | 0.039-0.33x0.117-0.33 |
| Y | | | |
| Extension of vitelline follicles | - | Post ovarian follicles absent | Post ovarian follicles present. |

Order : Tetraphyllidea Carus, 1863

Family : Phyllobothriidae Braun, 1900

Genus : *Anthobothrium* Van Beneden, 1850

Species :*Anthobothrium puriensis* n.sp.

(Plate - 11, Figs.1-2)

Two out of six dog fishes, *Scoliodon sorrakowah* (Cuvier) examined at Puri (Orissa) yielded eight cestodes from their intestines. Morphological studies of the cestodes revealed them to belong to the genus *Anthobothrium* Van Beneden, 1850 of the family Phyllobothriidae Braun, 1900 order Tetraphyllidea Carus, 1863.

Incomplete worms measure 4.0-7.0 x 0.03-0.25 (4.9x 0.19). Scolex oval to spherical measures 0.07-0.196x0.09-0.227 (0.12x0.17). Bothridia sessile, unarmed, nonloculated measure 0.058-0.15x0.058-0.15 (0.069x0.069). Myzorhynchus and median sucker absent.

Neck absent, Anterior immature proglottids broader than long while posterior ones longer than broad 0.006-0.25x0.031-0.156 (0.147x0.112). Mature proglottid longer than broad measures 0.175-0.612x0.157-0.253 (0.35x0.22). Detached gravid proglottids could not be obtained.

Testes oval to spherical in four lateral bands, anterior to female genitalia but beyond cirrus pouch level, testes form a continuous field. Testes 45-70 in number measure

0.015-0.039x0.015-0.039 (0.022x0.022). Anterior continuous field contains 10-18 testes while behind the level of cirrus pouch,poral half containing 15-22 and aporal half 15-25 testes in number. Cirrus pouch oval or tubular measures 0.098-0.157x0.019-0.058 (0.12x0.032) may extend to the middle of the proglottid. Cirrus unarmed. Internal and external seminal vesicles absent.

Female genitalia posteriorly situated. Ovary bilobed V-shaped measures 0.09-0.17x0.12-0.21 (0.13x0.16). Vitelline follicles disposed in two lateral bands measure 0.006-0.015x0.006-0.015 (0.012x0.012). Vagina 0.006-0.015(0.008) in diameter opens anterior to cirrus pouch in the genital atrium. Receptaculum seminis oval measures 0.029-0.058x0.011-0.039 (0.042 x 0.022). Mehlis gland oval to spherical measures 0.012-0.039x0.019-0.039 (0.029x0.029) located behind the ovarian isthmus.

Genital atrium measures 0.009-0.023x0.019-0.039 (0.013x0.022) deep and wide respectively. Genital openings unilateral located at the anterior half of the proglottid margin.

## D I S C U S S I O N

The present form comes closer to *Anthobothrium karuatayi* Woodland, 1934 and *Anthobothrium spinosum* Subhapradha, 1957.

From *A. karuatayi* Woodland, 1934 it differs in

having smaller worms,narrow scolex, nonloculated bothridia, absence of neck, greater number of testes forming continuous field above the cirrus pouch and V-shaped ovary. From *A. spinosum* Subhapradha, 1957 it differs in having sessile and unarmed bothridia, absence of neck, absence of spines on anterior proglottids, presence of continuous field of testes anterior to cirrus pouch level and V-shaped ovary.

In the light of above discussion the present form may be accommodated as a new species, *Anthobothrium puriensis* n.sp.

Host : *Scoliodon sorrakowah* (Cuvier)

Habitat : Small intestine

Locality : Puri, Orissa

Holotype : Post graduate Department of Zoology,
Bipin Behari College, Jhansi.

TABLE NO. 8

COMPARISON OF THE CHARACTERS OF THE SPECIES CLOSER TO THE *ANTHOBOTHRIUM PURIENSIS* n.sp.

| | *A.karuatayi* Woodland, 1934 | *A.spinosum* Subhapradha, 1957. | *A.puriensis* n.sp. |
|---|---|---|---|
| Size | 30.0x1.0 | - | 4.0-7.0x0.03-0.25 |
| Scolex | 0.24x0.4 | - | 0.07-0.196x0.09-0.227 |
| BOTHRIDIA Sessile/ Penunculate | Sessile | Pedunculate | Sessile |
| Armed/ Unarmed | Unarmed | Armed | Unarmed |
| Loculated/ Nonloculated | Loculated | Nonloculated | Nonloculated |
| Neck | Without spines | Covered with spines | Absent |
| Anterior proglottid | Without spines | Covered with spines | Without spines |
| TESTES Number | Under 50 | 50-60 | 45-70 |
| Disposition | In four rows, two on either side | In four rows, two on either side | In four rows, two on either side and a continuous field above the cirrus pouch. |
| Size | .04 | - | 0.015-0.039x0.015-0.039 |
| Ovary | Unilamilar bilobed. | H-shaped | Bilobed V-shaped |

Order : Tetraphyllidea Carus, 1863

Family : Phyllobothriidae Braun, 1900

Genus : *Anthobothrium* Van Beneden, 1850

Species : *Anthobothrium srivastavai* n.sp.

(Plate-12 Figs. 1-3)

Out of six dog fishes, *Scoliodon sorrakowah* (Cuvier) examined at Puri (Orissa), two were found infected with six cestodes in their intestine. Morphological studies of the cestodes revealed them to belong to the genus *Anthobothrium* Van Beneden, 1850 of the family Phyllobothriidae Braun, 1900 order Tetraphyllidea Carus, 1863.

Incomplete worms measure 3.0-5.0 x 0.038-0.582 (3.5x0.12). Scolex oval to spherical well demarcated from rest of the strobilae having four bothridia. Scolex measures 0.098-0.196x0.156-0.294 (0.145x0.235). Bothridia unarmed, sessile measures 0.058-0.117x0.058-0.137 (0.098x0.098).

Neck absent. Anterior immature proglottids broader than long while posterior ones longer than broad measures 0.011-0.176x0.011-0.098 (0.137x0.078). Mature proglottids longer than broad measures 0.588-1.969x0.098-0.392(0.799x0.145). Detached gravid proglottids could not be obtained.

Testes oval to spherical in two lateral bands anterior to female genitalia but beyond cirrus pouch level, testes form a continuous field. Testes 45-50 in number measures

0.026-0.059x0.026-0.059 (0.054x0.045). Anterior continuous field contains 9-13 testes while behind the level of cirrus pouch, poral half contains 18-24 and aporal half 15-20 testes in number. Cirrus pouch oval to round, may extend to the middle of the proglottid measures 0.058-0.137 x 0.058-0.137 (0.09x0.09). Cirrus unarmed. Internal and external seminal vesicles absent.

Female genitalia posteriorly situated. Ovary H-shaped measures 0.117-0.216 x 0.098-0.157 (0.169 x 0.108). Posteriorly the poral and aporal limbs of ovary never touch each other. Poral and aporal limbs of the ovary measure 0.117-0215x0.039-0.058 (0.169x0.049) and 0.117-0.215x0.039-0.058 (0.169x0.049) respectively. Vitelline follicles disposed in two lateral bands measure 0.009-0.019 x 0.009-0.019 (0.014x0.014).

Vagina measures 0.013-0.039 (0.025) in diameter opens anterior to cirrus pouch in the genital atrium. Receptaculum seminis oval to round measures 0.019-0.059x0.019-0.059 (0.029x0.034) located behind the ovarian isthmus. Mehlis gland absent.

Genital atrium measures 0.019-0.053x0.019-0.028 (0.021x0.021) deep and wide respectively. Genital openings unilateral located at the anterior half of the proglottid margin.

## D I S C U S S I O N

The present form comes closer to *Anthobothrium spinosum* Subhapradha 1957, *Anthobothrium hanumanthi* Srivastav *et*

Capoor, 1980 and *Anthobothrium sasoonense* Srivastav and Srivastava, 1988.

From *Anthobothrium spinosum* Subhapradha, 1957 it differs in having sessile, unarmed bothridia, absence of neck, unarmed anterior proglottids,testes in single row on either side. From *Anthobothrium hanumanthi* Srivastav *et* Capoor, 1980 it differs in having absence of myzorhynchus , absence of median sucker, absence of neck and presence of post ovarian vitellaria. From *Anthobothrium sasoonense* Srivastav and Srivastava, 1988 it differs in having nonloculated bothridia, absence of neck, lesser number of testes and posterior limb of ovary never touches each other.

In the light of above discussion the present form may be accommodated as a new species, *Anthobothrium srivastavai* n.sp.

The new species is named in the honour of an eminent Indian parasitologist, Dr. V.C. Srivastava, C.M.P., College, Allahabad.

Host : *Scoliodon sorrakowah* (Cuvier)

Habitat : Small intestine

Locality : Puri (Orissa)

Holotype : Postgraduate Department of Zoology,
Bipin Behari College, Jhansi.

TABLE NO. 9

COMPARISON OF THE CHARACTERS OF THE SPECIES CLOSER TO

*ANTHOBOTHRIUM SRIVASTAVAI* n.sp.

| | | *A.spinosum* Subhapradha, 1957 | *A.hanumanthi* Srivastav *et* Capoor,1980 | *A.sasoonense* Srivastav and Srivastava,1988 | *A.srivastavai* n.sp. |
|---|---|---|---|---|---|
| BOTHRIDIA | Sessile/ Pedunculate. | Pedunculate | Sessile | Sessile | Sessile |
| | Armed/ Unarmed. | Armed | Unarmed | Unarmed | Unarmed |
| | Loculated/ Nonloculated. | Nonloculated | Nonloculated | Loculated | Nonloculated |
| | Myzorhynchus | Absent | Present | Absent | Absent |
| | Median sucker | Absent | Present | Absent | Absent |
| | Neck | Covered with spine. | Without spine | Without spine | Absent |
| | Anterior proglottid | Covered with spine. | Without spine | Without spine | Without spine. |
| TESTES | Number | 50-60 | 45-80 | 50-70 | 45-50 |
| | Disposition. | In four rows two on either side. | In two rows and a conti- nuous field anterior to cirruspouch. | In two rows and a conti- nuous field anterior to cirruspouch. | In two rows and a cont- inous field anterior to cirruspouch. |

| | | | | | |
|---|---|---|---|---|---|
| OVARY | Shape | H-shaped | H-shaped | H-shaped | H-shaped |
| | Extension | Posterior limbs of ovary never touch each other. | Posterior limbs of ovary never touch each other. | Posterior limbs of ovary nearly meet posteriorly. | Posterior limbs of ovary never touch each other. |
| | Extension of vitelline follicles. | - | Post ovarian vitellaria. absent | Post ovarian vitellaria. absent | Post ovarian vitellaria. present. |

TABLE NO. 10

COMPARISON OF THE CHARACTERS OF *ANTHOBOTHRIUM BLOCHII* n.sp., *ANTHOBOTHRIUM PURIENSIS* n.sp. AND *ANTHOBOTHRIUM SRIVASTAVAI* n.sp.

| | | *A.blochii* n.sp. | *A.puriensis* n.sp. | *A.srivastavai* n.sp. |
|---|---|---|---|---|
| BOTHRIDIA | Sessile/ Pedunculate | Pedunculate | Sessile | Sessile |
| | Size | 0.036-0.078x 0.12-0.16 | 0.058-0. 15x 0.058-0. 15 | 0.058-0.117x 0.058-0.137 |
| | Neck | Present | Absent | Absent |
| | Mature proglottid | 0.294-0.588x 0.121-0.392 | 0.175-0.612x 0.157-0.253 | 0.588-1.969x 0.098-0.392 |
| TESTES | Number | 40-115 | 45-70 | 45-50 |
| | Size | 0.01-0.117x 0.01-0.117 | 0.015-0.039x 0.015-0.039 | 0.026-0.059x 0.026-0.059 |
| | Disposition | In many rows | In four rows and a continuous field anterior to cirrus pouch | In two rows and a continuous field anterior to cirrus pouch |
| | Ovary | U-shaped | Bilobed V-shaped | H-shaped |
| | Mehlis gland | Absent | Present | Absent. |

Order : Proteocephalidea Mola, 1928

Family : Proteocephalidae La Rue, 1911

Sub-family : Gangesiinae Mola, 1929

Genus : *Gangesia* Woodland, 1924

Species : *Gangesia chauhani* n.sp.

(Plate - 13 Figs. 1-6)

Out of four fishes, *Wallago attu* (Bl.& Schn.) examined at Jhansi, two were found infected with four cestodes in their intestines. Morphological studies of the cestodes revealed them to belong to the genus *Gangesia* Woodland, 1924 of the sub-family Gangesiinae Mola, 1929 family Proteocephalidae La Rue, 1911 order Proteocephalidea Mola, 1928.

Cestodes measure 30.0-65.0x0.117-1.12 (47.0x0.76). Scolex oval to round measure 0.196-0.314 x 0.196-0.344 (0.232x 0.242). Suckers oval to round, unarmed measure 0.058-0.196x 0.058-0.196 (0. 12 x 0. 13). Rostellum oval to round, protrusible measures 0.058-0.157 x 0.058-0.157 (0.073x0.073). Rostellum armed with a single circle of rostellar hooks. Rostellar hooks 18-24 (20) in number measure 0.004-0.021 (0.011) in length.

Neck distinct 2.94-5.88x0.156-0.352 (4.13x0.267). Proglottids longer than broad.

Immature proglottids measure 0.196-0.49x0.196-0.392 (0.293x0.242), mature proglottids 0.784-1.372 x 0.49-0.98 (0.992x 0.723) and gravid proglottids 0.98-3.23 x 0.392-1.12 (1.23x0.732).

Testes oval to round 70-95 in number measure 0.0196-0.078x0.0196-0.078 (0.032x0.032), which never extend beyond the ventral longitudinal excretory canals. Cirrus pouch elongate measure 0.196-0.392x0.058-0.156 (0.252x0.098), crosses the poral ventral longitudinal excretory canal. Cirrus unarmed measures 0.029-0.157 (0.082) in diameter. Internal and external seminal vesicle absent.

Female genitalia posteriorly situated. Ovary bilobed measures 0.056-0.39 x 0.114-0.698 (0.197x0.363). Vitelline follicles form two lateral bands measure 0.003-0.013x0.001-0.012 (0.008x0.004). Receptaculum seminis oval to round 0.04-0.07x 0.05-0.07 (0.05x0.06).

Genital atrium measures 0.011-0.058 x 0.019-0.068 (0.032x0.034) deep and wide respectively. Genital pores alternate irregularly, located in anterior half of the proglottid.

Uterus initially tube like later on branched with 10-22 lateral diverticulae filled with eggs.

Eggs numerous, oval to round measure 0.029-0.058x 0.029-0.058 (0.042x0.042). Onchosphere 0.019-0.039 (0.034) in diameter. Ventral longitudinal excretory canal measures 0.003-0.013 (0.008) in diameter.

## D I S C U S S I O N

The present form comes closer to *Gangesia*

*oligonchis* Roitman *et* Freze (1964), *Gangesia parasiluri* Yamaguti (1934), *Gangesia pseudobagrae* Chen. Yen-hsin (1962) and *Gangesia sanehensis* Malhotra, Capoor and Shinde (1980).

The present form differs from *Gangesia oligonchis* Roitman *et* Freze, 1964 in having larger rostellum, unarmed sucker, larger eggs and larger onchospheres. From *Gangesia parasiluri* Yamaguti, 1934 in having smaller scolex, smaller rostellum, smaller number of rostellar hooks and unarmed sucker. From *Gangesia pseudobagrae* Chen yen-hsin, 1962 in having smaller worms, smaller rostellum, smaller number of rostellar hooks and larger eggs. From *Gangesia sanehensis* Malhotra, Capoor and Shinde, 1980 in having smaller scolex, smaller rostellum, smaller rostellar hooks, unarmed suckers, larger neck, smaller mature and gravid proglottids, lesser number of testes and unarmed cirrus.

In the light of above discussion the present form may be accommodated as a new species, *Gangesia chauhani* n.sp.

The species is named after the eminent Indian Helminthologist Dr. B.S. Chauhan, former vice-chancellor, Sagar University, Sagar (M.P.)

Host : *Wallago attu*

Habitat : Small intestine

Locality : Jhansi

Holotype : Postgraduate Department of Zoology,
Bipin Behari College, Jhansi.

TABLE No. 11

COMPARISON OF THE CHARACTERS OF THE SPECIES CLOSER TO GANGESIA CHAUHANI n. sp.

| | G. oligonchis Roitman et Freze, 1964 | G. parasiluri Yamaguti 1934 | G. pseudobagrae Chen yen-hsin, 1962 | G. sanehensis Malhotra, Capoor & Shinde, 1980 | G. chauhani n. sp. |
|---|---|---|---|---|---|
| Size | 45.0x2.2 | 40.0x1.0 | 120.0-270.0x 1.2-1.8 | 15.6-18.9x2.915 | 30.0-65.0x 0.117-1.12 |
| Scolex | 0.20-0.24x0.24-0.30 | 0.33 wide | ------ | 0.435-0.5666x 0.450-0.566 | 0.196-0.314x 0.196-0.344 |
| Rostellum | 0.026-0.034x 0.034-0.068 | 0.125x0.175 | 0.16-0.25 | 0.126-0.263x0.160-0.288 | 0.058-0.117x 0.058-0.117 |
| **ROSTELLAR HOOKS** | | | | | |
| Number | 26-30 | 32-37 | 33-38 | 22-28 | 18-24 |
| Size | Basal plate 0.014-0.018x0.010 length of hook - 0.014-0.022 | 0.020 | 0.023-0.031 long | 0.027-0.46 long | 0.004-0.021 long |
| Sucker | armed | armed | ----- | armed | unarmed |
| Neck | 0.157-0.160x0.33-0.36 | 3.2x0.26 | ---- | 0.537-0.885x0.334-0.479 | 2.94-5.88x 0.156-0.352 |
| **PROGLOTTID** | | | | | |
| Mature | 0.20-0.23x0.64-0.88 | ----- | ----- | 0.087-1.189x0.508-1.407 | 0.784-1.372x 0.49-0.98 |
| Gravid | ----- | ----- | ----- | 1.001-4.843x 0.552-2.915 | 0.98-3.23x 0.392-1.12 |
| No. of testes | 88-103 | 90-100 | 80-100 | 112-184 | 70-95 |
| **CIRRUS** | | | | | |
| Size | 0.656x0.030-0.080 | ----- | ----- | 0.045-0.221 dia. | 0.029-0.157 dia. |
| armed/unarmed | ----- | ----- | ----- | armed | unarmed |
| Egg | 0.027-0.031x 0.025-0.028 | ----- | 0.031-0.033 dia. | 0.018-0.059x 0.023-0.068 | 0.029-0.058 dia |
| onchosphere | 0.014-0.017 dia. | ----- | ----- | 0.011-0.027x0.14-0.038 | 0.019-0.039 dia. |

Order : Proteocephalidea Mola, 1928

Family : Monticellidae La Rue, 1911

Sub-family : Zygobothriinae Woodland, 1933

Genus : *Nomimoscolex* Woodland, 1934

Species : *Nomimoscolex shrotrii* n.sp.

(Plate-14, Figs. 1-5 )

Out of five *Heteropneustes fossilis* (Bloch.) examined at Jhansi, two were found infected with three cestodes in their intestines. Morphological studies of the cestodes revealed them to belong to the genus *Nomimoscolex* Woodland, 1934 of the sub family Zygobothriinae Woodland, 1933 family Monticellidae La Rue, 1911 and order Proteocephalidea Mola, 1928.

Cestodes measure 10.2-20.6 in length and 2.35 in maximum width. Scolex oval to round measures 0.392-0.492x 0.431-0.627 (0.422 x 0.563). Apical organ measures 0.12-0.19x 0.15-0.22 (0.15x0.18). Suckers oval to round measure 0.196-0.393x 0.196-0.393 (0.232x0.232). Neck absent.

Proglottids wider than long. Immature proglottids measure 0.137-0.294x0.392-0.744 (0.173x0.572), mature proglottids measure 0.352-0.821x1.176-2.16 (0.621x1.76) and gravid proglottids measure 0.692-1.57x1.17-2.35 (1.32x1.83).

Testes oval to round 180-210 in number measure 0.039-0.098x0.039-0.098 (0.059x0.059) scattered throughout the proglottid which never cross the ventral longitudinal excretory

canals. Cirrus pouch tubular 0.235-0.41x0.039-0.137 (0.27x0.062) extend upto the 1/5th width of proglottid. Internal and external seminal vesicles absent.

Female genitalia posteriorly situated. Ovary bilobed, medullary measures 0.039-0.316x0.627-1.576 (0.056x0.892). Vitelline follicles in two lateral bands in cortical region measure 0.011-0.039x0.011-0.039 (0.015x0.015). Vagina measures 0.013-0.039 (0.02) in diameter opens anterior to cirrus pouch in the genital atrium. Receptaculum seminis measures 0.129-0.149x 0.098-0.137 (0.135x0.11). Initially uterus a tube like structure but later on sac like with 2-4 diverticulae filled with eggs.

Genital atrium 0.019-0.078x0.019-0.11 (0.052x0.072) deep and wide respectively. Genital pores irregularly alternating in the anterior half of the proglottid margin.

Eggs oval to round measure 0.011-0.043x0.011-0.043 (0.025x0.028). Onchosphere oval to round measures 0.009-0.013x 0.009-0.013 (0.01x0.011).

Ventral longitudinal excretory canal measures 0.011-0.026 in diameter.

## D I S C U S S I O N

The present form comes closer to *Nomimoscolex lenha* Woodland, 1933 and *Nomimoscolex sudobim* Woodland, 1935.

From *Nomimoscolex lenha* Woodland, 1933 it differs

in having shorter worms, larger scolex, presence of apical organ, absence of neck and lesser number of uterine diverticulae from *Nomimoscolex sudobim* Woodland, 1935 it differs in having shorter worms, larger scolex, presence of apical organ, absence of neck, wider mature proglottid and smaller number of testes.

In the light of above discussion the present form may be accommodated as a new species *Nomimoscolex shrotrii* n.sp.

The new species is named in the honour of Dr. S.C.Shrotriy, Principal, Bipin Behari Post Graduate College, Jhansi.

Host : *Heteropneustes fossilis* (Bloch.)

Habitat : Small intestine

Locality : Pahuj dam, Jhansi

Holotype : Postgraduate Department of Zoology,
Bipin Behari College, Jhansi.

TABLE NO. 12

COMPARISON OF THE CHARACTERS OF SPECIES CLOSER TO *NOMIMOSCOLEX SHROTRII* n.sp.

| | | *N.lenha* Woodland, 1933 | *N.Sudobim* Woodland, 1935 | *N.shrotrii* n.sp. |
|---|---|---|---|---|
| | Size | 130.0x2.59 | 53.0x1.2 | 10.0-20.0x 0.333-2.35 |
| | Scolex | 0.16-0.28x 0.19-0.28 | 0.199-0.215x 0.116-0.149 | 0.392-0.492x 0.431-0.627 |
| | Apical organ | absent | absent | 0.12-0.19x 0.15-0.22 |
| | Length of neck | 0.47-0.88 | 0.24-0.33 | absent |
| | Mature proglottid | - | 0.41x0.20 | 0.352-0.821x 1.176-2.16 |
| TESTES | Number | More than 200 | 200-250 | 180-210 |
| TESTES | Size | - | 0.054 in diameter | 0.039-0.098x 0.039-0.098 |
| | Cirrus pouch | - | 0.38x0.149 | 0.235-0.41x 0.039-0.137 |
| | Vitelline follicles | - | 0.027 diameter | 0.011-0.039x 0.011-0.039 |
| | Number of utrine diverticulae | 17-18 on each side | - | 2-4 |

# PART-C

# OBSERVATION

To study the nature of cestode infection in fresh water cat fish, *Heteropneustes fossilis* (Bloch.) one hundred and twelve fishes were examined (about five hosts per month) for two successive years since February 1989 to January 1991. Out of 112 hosts examined, only 12 were found infected with 26 cestodes. Thus the average annual prevalence of cestode infection in singhi fish was (0.107), mean intensity (2.166) and the relative density (0.232). Only 20 nematodes were obtained from 8 fishes. Thus the prevalence of nematode infection was (0.071), mean intensity (2.5) and the relative density (0.178). Only 2 trematodes were found from single fish. Thus the prevalence of trematode infection was (0.008), mean intensity (2.00) and relative density (0.017). Only 40 acanthocephala were obtained from 11 fishes. Thus the prevalence of acanthocephala infection was (0.098), mean intensity (3.636) and relative density (0.357) (Table 13 Plate 15 & 16) Average seasonal variations in the prevalence, mean intensity and relative density of cestodes infecting the singhi fishes were as follows.

The prevalence of cestode infection was highest during summer season (0.177) and lowest in winter (0.049) (Table 14 Plate 17). The mean intensity of cestode infection was highest during summer (2.375) and lowest during winter (1.5) (Table 14 Plate 17). The relative density of cestode infection was also

highest in summer (0.422) and lowest during winter (0.073) (Table 14 Plate 18). Average month wise variations in the prevalence, mean intensity and relative density of the cestode infection in *Heteropneustes fossilis* have been depicted in (Table 15 Plate 19 & 20). The maximum prevalence was recorded in the months of April and September (0.333) where as minimum (0) in December, January, June, July and August. In rest of the months it ranges in between 0.062 to 0.312 (Table 15 Plate 19). The maximum mean intensity (3.0) was recorded in October where as minimum (0)in December, January, June, July and August. In rest of the months it ranges from 1.0 to 2.8 (Table 15 Plate 19). The relative density (0.875) was maximum in the month of March where as minimum (0) in December, January, June, July and August. In rest of the months it ranges from 0.062 to 0.428 (Table 15 Plate 20).

I- CESTODE INFECTION IN RELATION TO THE BODY WEIGHT OF THE HOST :-

(a) Average annual variations :- (Table 16 Plate 21 & 22)

(i) Prevalence :-

Maximum prevalence of cestode infection (0.235) was recorded in the host ranging from 151-200g. body weight while minimum (0.027) was recorded in the host ranging from 101-150g. body weight.

(ii) Mean intensity :-

Maximum mean intensity of cestode infection (2.5) was recorded in the host ranging from 51-100g. body weight

while minimum (2.0) was recorded in the host ranging from 101-150g. and 151-200g. body weight.

(iii) Relative density :-

Maximum relative density (0.47) of cestode infection was recorded in the host ranging from 151-200g. body weight while minimum (0.055) was recorded in the host ranging from 101-150g. body weight.

(b) Average seasonal variation :- (Table 17 {A,B,C,D} Plate 23, 24, 25, 26, 27 & 28).

(i) Prevalence :- (Table 17 {A,B,C,D} Plate 23 & 24)

The maximum prevalence (0.6) was recorded in the host body weight ranging from 151-200g. during summer.

The minimum prevalence (0) was recorded in the host body weight ranging from 51-100g., 101-150g. during winter and 101-150g and 151-200g. during rainy season.

(ii) Mean Intensity :- (Table 17 {A,B,C,D} Plate 25 & 26)

The maximum mean intensity of the cestode infection was (3.0) as recorded in the hosts body weight ranging from 51-100g. during rainy season.

The minimum mean intensity of the cestode infection (0) was recorded in the host body weight ranging from 51-100g., 101-150g. during winter and 101-150g, 151-200. during rainy season.

(iii) Relative density :- (Table 17 {A,B,C,D} Plate 27 & 28)

The maximum relative density of cestode infection (1.4) was recorded in the host body weight ranging from 151-200g. during summer season.

The minimum relative density of cestode infection (0) was recorded in the host body weight ranging from 51-100g., 101-150g. during winter and 101-150g., 151-200g. during rainy season.

(c) Average monthwise variation :- (Table 18 {A,B,C,D} Plate 29, 30, 31, 32, 33, 34, 35 & 36)

(i) Prevalence :-

In the host body weight ranging from 51-100g. the maximum prevalence (0.16) was recorded in March where as minimum (0) in December, January, February, May, June and July. No host of this body weight range was available for examination in November, April, August and September. In the host body weight ranging from 101-150g. the maximum prevalence(0.25) was recorded in March where as minimum (0) in November,December,January, February, April,May, June, July and September. No host of this body weight range was available for examination in August and October. In the host body weight ranging from 151-200g the maximum prevalence (1.0) was recorded in April where as minimum (0) was recorded in November, January, June, July and September. No host of this body

weight range was available for examination in December, May,August and October. In the host body weight ranging from 201-250g. the maximum prevalence (1.0) was recorded in September where as minimum (0) in December, January, February, June, July and August. No host of this body weight range was available for examination in October.

(ii) Mean intensity:-

In the host body weight ranging from 51-100g. the maximum mean intensity (3.0) was recorded in the month of October while minimum (0) in December, January, February, May, June and July. No host of this body weight range was available for examination in November, April, August and September. In the host body weight range 101-150g. the maximum mean intensity (2.0) was recorded in March where as minimum (0) was recorded in November December, January, February,April,May,June,July and September. No host of this body weight range was available for examination in August and October. In the host body weight ranging from 151-200g the maximum mean intensity (3.0) was recorded in the month of March where as minimum (0) in November, January, June, July and September. No host of this body weight range was available for examination in December, May, August and October. In the host body weight ranging from 201-250g. the maximum mean intensity (4.0) was recorded in March where as minimum (0) in December,January, February, June, July and August. No host of this

body weight range was available for examination in the month of October.

(iii) Relative density:-

In the host body weight ranging from 51-100g. the maximum relative density (0.42) was recorded in October while minimum (0) in December, January, February, May, June and July.No host of this body weight range was available for examination in November, April, August and September. In the host body weight ranging from 101-150g. the maximum relative density (0.5) was recorded in March while minimum (0) was recorded in November December, January, February,April,May,June, July and September. No host of this body weight range was available for examination in August and October. In the host body weight ranging from 151-200g.the maximum relative density (2.0) was recorded in March while minimum (0) in November, January,June, July and September.No host of this body weight range was available for examination in December,May,August,and October.In the host body weight ranging from 201-250g. the maximum relative density (1.3) was recorded in March where as minimum (0) was recorded in December, January, February, June, July and August. No host of this body weight range was available for examination in October.

## II- CESTODE INFECTION IN RELATION TO THE SEX OF THE HOST :-

(a) Average annual variation:- (Table 19 Plate 37 & 38)

(i) Prevalence :-

The prevalence of cestode infection was 0.072 in males and 0.14 in females.

(ii) Mean intensity :-

The mean intensity of cestode infection was 1.75 in males and 2.37 in females.

(iii) Relative density :-

The relative density of cestode infection was 0.127 in males 0.333 in females.

(b) Average seasonal variations :- (Table 20 {A&B} Plate 39 & 40)

(i) Prevalence :-

In Males :-

The maximum prevalence (0.166) was recored in summer while minimum (0) in winter and rainy season.

In Females :-

The maximum prevalence (0.19) was recorded in summer while minimum (0.086) in winter.

(ii) Mean intensity :-

In Males :-

The maximum mean intensity (1.75) was recorded in summer while minimum (0) in winter and rainy season.

In Females :-

The maximum mean intensity (3.0) was recorded in summer while minimum (1.5) in winter.

(iii) Relative density :-

In Males :-

The maximum relative density (0.291) was recorded in summer while minimum (0) in winter and rainy season.

In Females :-

The maximum relative density (0.571) was recorded in summer and minimum (O.13) in winter.

(c) Average monthwise variations :- (Table 21 {A & B} Plate 41, 42,43,44)

In Males :- (Table 21 {A} Plate 41 & 42)

(i) Prevalence :-

The maximum prevalence (0.5) was recroded in April while minimum (0) was recorded in January, February, June, July August ,September,October, November and December. In rest of the months it ranges from 0.14 to 0.18.

(ii) Mean intensity :-

The maximum mean intensity (2.0) was recorded in the months of March and May while minimum (0) in January, February, June, July, August, September,October, November and December. In April it is (1.0)

(iii) Reletive density :-

The maximum relative density (0.50) was recorded in April while minimum (0) in January, February,

June, July, August, September, October,November and December. In rest of the months it ranges from 0.28 to 0.36.

In Females :- (Table 21 {B} Plate 43 & 44)

(i) Prevalence :-

The maximum prevalence (1.0) was recorded in the month of September while minimum (0) in January, May, June ,July, August, and December. In rest of the months it ranges from 0.11 to 0.6.

(ii) Mean intensity :-

The maximum mean intensity (3.33) was recorded in March while minimum (0) in January, May, June, July, August and December. In rest of the months it ranges from 1.0 to 3.0

(iii) Relative density :-

The maximum relative density (2.0) was recorded in the month of March while minimum (0) in January, May, June, July, August and December. In rest of the months it ranges from 0.11 to 1.0.

III- CESTODE INFECTION IN RELATION TO THE CLOACAL TEMPERATURE OF THE HOST :-

(a) Average annual variation :- (Table 22 Plate 45 & 46)

(i) Prevalence :-

Maximum prevalence of cestode infection (0.18) was recorded in the host ranging from 78-85`F cloacal temperature while minimum (0) in the host cloacal temperature

ranging 70-77`F and 94 -101`F.

(ii) Mean intensity :-

Maximum mean intensity of cestode infection (2.3) was recorded in the host ranging from 78-85`F cloacal temperature while minimum (0) was recorded in the host ranging from 70-77`F and 94-101`F cloacal temperature.

(iii) Relative density :-

Maximum relative density of cestode infection (0.43) was recorded in the host ranging from 78-85`F cloacal temperature while minimum (0) in the host ranging from 70-77`F and 94-101`F cloacal temperature.

(b) Average seasonal variation :- (Table 23 {A,B,C,D} Plate 47,48,49,50,51 & 52)

(i) Prevalence :- (Table 23 {A,B,C,D} Plate 47 & 48)

The maximum prevalence (0.32) was recorded in the host cloacal temperature ranging from 78-85`F in summer season.

The minimum prevalence (0) was recorded in the host cloacal temperature ranging from 70-77`F in winter, 94-101`F in summer and rainy season. Cloacal temperature ranging from 86-93`F and 94-101`F in winter and 70-77`F in summer and rainy season can not be studied because fishes belongs to poikelothermic group.

(ii) Mean intensity :- (Table 23 {A,B,C,D} Plate 49 & 50)

The maximum mean intensity (3.0) was recorded in the host cloacal temperature ranging from 78-85`F in rainy season.

The minimum mean intensity of cestode infection (0) was recorded in the host cloacal temperature ranging from 70 - 77`F in winter, 94-101`F in summer and rainy season. Cloacal temperature ranging from 86-93`F and 94-101`F in winter and 70-77`F in summer and rainy season can not be studied because fishes belongs to poikelothermic group.

(iii) Relative density :- (Table 23 {A,B,C,D} Plate 51 & 52)

The maximum relative density (0.77) was recorded in the host cloacal temperature ranging from 78-85`F in summer.

The maximum relative density (0) was recorded in the host cloacal temperature ranging from 70-77`F in winter, 94-101`F in summer and rainy season. Cloacal temperature ranging from 86-93`F and 94-101`F in winter and 70-77`F in summer and rainy season can not be studied because fishes belongs to poikelothermic group.

(c) Average monthwise variation :- (Table 24 {A,B,C,D} Plate 53,54,55 & 56)

(i) Prevalence :-

Fishes having 70-77`F cloacal temperature showed no infection. This temperature could not be persist in November, February, March, April, May, June,July, August, September and

October. In the host having cloacal temperature ranging from 78-85`F the maximum prevalence(0.333) was recorded in the month of April while minimum (0.062) was recorded in the month of February. In the months December, January, May, June, July, August and September this temperature could not persist. In the host having cloacal temperature ranging from 86-93`F the maximum prevalence (0.333) was recorded in September while minimum (0) in August. This temperature could not persist in November, December, January, February, March, April, June, July, and October. In the host having cloacal temperature ranging from 94-101`F showed no infection. This temperature could not persist in November, December, January, February, March, April, May,August September and October.

(ii) Mean intensity :-

Fishes having 70-77`F cloacal temperature showed no infection. This temperature could not persist in November February, March, April, May, June, July, August, September and October. In the host having cloacal temperature ranging from 78-85`F the maximum mean intensity (3.0) in October while minimum (1.0) in February. This temperature could not persist in December, January, May, June, July, August and September. In the host having cloacal temperature ranging from 86-93`F maximum mean intensity (2.0) in May while minimum (0) in August. This

temperature could not persist in November, December, January February, March, April, June, July, and October. In the host having cloacal temperature ranging from 94-101`F showed no infection.This range of cloacal temperature could not persist in November, December, January, February, March, April, May, August, September and October.

(iii) Relative density :-

Fishes having cloacal temperature 70-77`F showed no infection.This range could not persist in November, February, March, April, May, June, July, August, September, and October. The cloacal temperature ranging from 78-85`F showed maximum relative density (0.875) in the month of March while minimum (0.062) in February. This temperature range could not persist in December, January, May, June, July , August and September. In the host having cloacal temperature ranging from 86-93`F showed maximum relative density (0.333) in September while minimum (0) in August. This temperature range could not persist in November,December, January, February, March, April, June, July and October. In the host having cloacal temperature ranging from 94-101`F showed no infection. This temperature range could not persist in November, December, January, February, March, April,May August, September and October.

# DISCUSSION AND CONCLUSIONS

The fish *Heteropneustes fossilis* (Bloch.) generally infected with helminth parasites viz. cestodes, trematodes, nematodes and acanthocephala. Kinsella (1966) reported the dominance of nematodes over the trematode and cestode infection in frogs. Srivastava A.N. (1987) reported the dominance of cestode infection over the nematode and trematode infection in doves. Srivastava B.K.(1989) reported the dominance of cestode infection in domestic fowls.During the course of present investigation in *Heteropneustes fossilis* however, it was noted that acanthocephala constitute the dominant group of helminths, in their prevalence, mean intensity and relative density over the nematode, cestode and trematode infection (Table 13 Plate 15 & 16) but cestodes show second dominant group (Table 13 Plate 15 & 16) over nematode and trematode prevalence, mean intensity and relative density. In the present project the author has restricted herself to the ecological nature of infection, prevalence mean intensity and relative density of cestode parasites only.

The prevalence of cestodes in *Heteropneustes fossilis* has been found to be highest during summer (table 14 plate 17) in the present observations. This phenomenon may be related to the relative incidence of the intermediate hosts of these parasites. According to Jha & Sinha (1990) food of

*Heteropneustes fossilis* comprised of crustaceans, dipteran Larvae, algal mass, debris, insect larvae, adult insects and molluscs. Crustacean, adult insects and molluscs acts as intermediate host which is affected by water temperature. Cestodes shows an increase in their prevalence, mean intensity and relative densisty in summer specially in spring season. This may be attributed to a resumption of feeding by the host at the end of winter, with its apportunities of aquiring new infection . A similar spring rise in the number of helminths has been reported by Markov and Rogoza (1955). Lees (1962) also reported the highest incidence of parasitization by helminths occured in the autumn in United Kingdom, where insects and other arthropods reappear after winter diapause with the maximum in spring i.e. helminth abundance follows intermediate host abundance. Kinsella (1966) reported parasitic prevalence during summer and rainy season and believes that the greater occurance of arthropods in this season is the sole reason for their prevalence. From the available reports thus a strong indication exists that there is a definite correlation between the occurence of the parasites and their intermediate hosts during the year.

The prevalence of cestodes show a decline in winter (Table 14 Plate 17). This again seems to be related to the minimum occurence of intermediate host during winter.The highst

mean intensity of cestode infection was recorded in summer (Table 14 Plate 17). Apparently new infection is acquired in late winter and since the hosts may not possess immumity, the mean intensity rises to a very great extent in early summer. Again as infection continues, surviving hosts develop some immunity and hence mean intensity of cestodes infection dicreases in late summer and late winter. This corresponds to the fact that prevalence is directly proportional to the mean intensity of infection. Lees (1962) and Mazuromovich (1951) suggest lack of adequate food as the reason for their decline. A similar explanation can also be proposed for the relative density of cestodes which was higher in summer and lowest in winter.

CESTODE INFECTION AND HOST BODY WEIGHT :-

The body weight of host is related to a number of factors like age, health, length and availability of food. The present observation indicates that the fish of intermediate body weight (151-200g.) shows greater prevalence and relative density of cestodes (Table 16 Plate 21 & 22). This finding is in agreement to that of Eure (1976) in fishes. He found intermediate sized fish with highest intensity of infection. Jha and Sinha (1990) also reported the higher prevalence and intensity of acanthocephala occurence in middle length groups and comparatively lower occurence in lower and higher length groups of *Channa*

*punctatus*. This finding is also reported by Amin (1986) for *Neoechinorhynchus cylindratus* (Van Cleave, 1913) who found a modest increase in worm burden by host size, which however bacame reversed in the largest males and females. He further mentioned that the decreased worm burden in largest fish may have been caused by age and related factors such as changes in feeding habits.

CESTODE INFECTION AND SEX OF THE HOST :-

In the present observations female fishes show higher annual prevalence,mean intensity and relative density of cestode infection than the male fishes (Table 19 Plate 37 & 38). Kennedy (1969) while working on the incidence of *Caryophylleus laticeps* in the dace, *Leuciscus leuciscus* has reported that degree of infection is higher in females than in males. The present observation support Kennedy's interpretations that females are possibly less resistant to the helminth infection because of the greater stress placed on them due to the frequent changes in their hormonal balance. Thomas (1964) has attributed this fact to the differences in the physiological resistance of males and females. Mutafova (1976) established greater survival rate by *H. gallinae* in natural bulgarian female chicken infection than in males. Srivastava (1989) reported the higher prevalence, mean intensity and relative density in females while working on

domestic fowl. Malhotra (1992) reported heavier infestation in female *Wallago attu* than in male fishes. Saberwal, Malhotra and Capoor (1992) reported higher prevalence and intensity of proteocephalids, *G. hanumanthai* in females than in male fishes.

CESTODE INFECTION AND CLOACAL TEMPERATURE OF HOST :-

The present observation show higher prevalence, mean intensity and relative density at 78`F -85`F (25.5`C-29.4`C) temperature. According to Chubb (1977)and Kearn (1986) temperature affects egg production, larval development, maturation and worm survival in many fish monogeneans, thus controlling seasonal population cycles. Esch (1983) reported that in many cestodes temperature is the single most important factor influencing seasonal cycles, either directly, affecting recruitment and mortality or indirectly, affeting host immune responses and predator-prey interaction between final and intermediate hosts. The present observation also supports Tocque and Tinsley (1991) interpretation that maximum growth occured at 25`C and decline above 34`C and below 16`C. Malhotra (1992) reported that parasites optimum has been identified as $25.0 \pm 3.0$`C in *Gallus gallus domesticus*.

TABLE NO. 13

AVERAGE ANNUAL VARIATIONS IN THE PREVALENCE, MEAN INTENSITY AND RELATIVE DENSITY OF HELMINTH INFECTION IN *HETEROPNEUSTES FOSSILIS* (*BLOCH.*)

| | | |
|---|---|---|
| Number of hosts examined | | 112 |
| Number of hosts infected with | Cestode | 12 |
| | Nematode | 8 |
| | Trematode | 1 |
| | Acanthocephala | 11 |
| Prevalence of | Cestode | 0.107 |
| | Nematode | 0.071 |
| | Trematode | 0.008 |
| | Acanthocephala | 0.098 |
| Number of worms obtained | Cestode | 26 |
| | Nematode | 20 |
| | Trematode | 2 |
| | Acanthocaphala | 40 |
| Mean intensity | Cestode | 2.166 |
| | Nematode | 2.50 |
| | Trematode | 2.0 |
| | Acanthocephala | 3.636 |

| | | |
|---|---|---|
| Relative density | Cestode | 0.232 |
| | Nematode | 0.178 |
| | Trematode | 0.017 |
| | Acanthocephala | 0.357 |

## TABLE NO. 14

**AVERAGE SEASONAL VARIATIONS IN THE PREVALENCE, MEAN INTENSITY AND RELATIVE DENSITY OF CESTODE INFECTION IN *HETEROPNEUSTES FOSSILIS*.**

| Season | Number of hosts | | Prevalence | Number of cestode obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| | Examined | Infected | | | | |
| Winter | 41 | 2 | 0.049 | 3 | 1.5 | 0.073 |
| Summer | 45 | 8 | 0.177 | 19 | 2.375 | 0.422 |
| Rainy | 26 | 2 | 0.077 | 4 | 2.0 | 0.154 |

## TABLE NO. 15

AVERAGE MONTHWISE VARIATIONS IN THE PREVALENCE,MEAN INTENSITY AND RELATIVE DENSITY OF CESTODE INFECTION IN *HETEROPNEUSTES FOSSILIS*.

| Month/ Year | Number of hosts Examined | Number of hosts Infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| Feb.(89&90) | 16 | 1 | 0.062 | 1 | 1.0 | 0.062 |
| March (89&90) | 16 | 5 | 0.312 | 14 | 2.8 | 0.875 |
| April (89&90) | 6 | 2 | 0.333 | 3 | 1.5 | 0.5 |
| May (89&90) | 13 | 1 | 0.076 | 2 | 2.0 | 0.153 |
| June (89&90) | 10 | 0 | 0 | 0 | 0 | 0 |
| July (89&90) | 14 | 0 | 0 | 0 | 0 | 0 |
| Aug.(89&90) | 2 | 0 | 0 | 0 | 0 | 0 |
| Sept.(89&90) | 3 | 1 | 0.333 | 1 | 1.0 | 0.333 |
| Oct.(89&90) | 7 | 1 | 0.142 | 3 | 3.0 | 0.428 |
| Nov.(89&90) | 8 | 1 | 0.125 | 2 | 2.0 | 0.25 |
| Dec.(89&90) | 7 | 0 | 0 | 0 | 0 | 0 |
| Jan.(89&90) | 10 | 0 | 0 | 0 | 0 | 0 |

TABLE NO. 16

AVERAGE ANNUAL VARIATIONS IN THE PREVALENCE, MEAN INTENSITY AND RELATIVE DENSITY OF CESTODE INFECTION IN RELATION TO THE BODY WEIGHT OF THE HOST.

| Range of the body weight(g.) | Number of hosts Examined | Number of hosts Infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| 51-100 | 31 | 2 | 0.064 | 5 | 2.5 | 0.161 |
| 101-150 | 36 | 1 | 0.027 | 2 | 2.0 | 0.055 |
| 151-200 | 17 | 4 | 0.235 | 8 | 2.0 | 0.470 |
| 201-250 | 27 | 5 | 0.185 | 11 | 2.2 | 0.407 |

TABLE NO. 17 (A, B, C, D)

AVERAGE SEASONAL VARIATIONS IN THE PREVALENCE, MEAN INTENSITY AND RELATIVE DENSITY OF CESTODE INFECTION IN RELATION TO THE BODY WEIGHT OF THE HOST.

TABLE NO. 17-A

BODY WEIGHT OF THE HOST 51-100 g.

| Season | Number of hosts Examined | Number of hosts infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| Winter | 11 | 0 | 0 | 0 | 0 | 0 |
| Summer | 9 | 1 | 0.111 | 2 | 2.0 | 0.222 |
| Rainy | 11 | 1 | 0.09 | 3 | 3.0 | 0.272 |

TABLE NO. 17-B

BODY WEIGHT OF THE HOST 101-150 g.

| Season | Number of hosts | | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| | Examined | Infected | | | | |
| Winter | 11 | 0 | 0 | 0 | 0 | 0 |
| Summer | 17 | 1 | 0.058 | 2 | 2.0 | 0.177 |
| Rainy | 8 | 0 | 0 | 0 | 0 | 0 |

TABLE NO. 17-C

BODY WEIGHT OF THE HOST 151-200 g.

| Season | Number of hosts Examined | Number of hosts Infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| Winter | 10 | 1 | 0.1 | 1 | 1.0 | 0.1 |
| Summer | 5 | 3 | 0.6 | 7 | 2.33 | 1.4 |
| Rainy | 2 | 0 | 0 | 0 | 0 | 0 |

TABLE NO. 17-D

BODY WEIGHT OF THE HOST 201-250 g.

| Season | Number of hosts | | Prevalence | Number of cestode obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| | Examined | Infected | | | | |
| Winter | 9 | 1 | 0.11 | 2 | 2.0 | 0.22 |
| Summer | 13 | 3 | 0.23 | 8 | 2.66 | 0.615 |
| Rainy | 5 | 1 | 0.20 | 1 | 1.0 | 0.20 |

TABLE NO. 18 (A, B, C, D)

AVERAGE MONTHWISE VARIATIONS IN THE PREVALENCE,MEAN INTENSITY AND RELATIVE DENSITY OF CESTODE INFECTION IN RELATION TO THE BODY WEIGHT OF THE HOST.

TABLE NO. 18-A

BODY WEIGHT OF THE HOST 51-100 g.

| Month/ Year | Number of hosts Examined | Number of hosts Infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| Feb. (89&90) | 7 | 0 | 0 | 0 | 0 | 0 |
| March (89&90) | 6 | 1 | 0.16 | 2 | 2.0 | 0.33 |
| April (89&90) | - | - | - | - | - | - |
| May (89&90) | 2 | 0 | 0 | 0 | 0 | 0 |
| June (89&90) | 1 | 0 | 0 | 0 | 0 | 0 |
| July (89&90) | 4 | 0 | 0 | 0 | 0 | 0 |
| Aug.(89&90) | - | - | - | - | - | - |
| Sep.(89&90) | - | - | - | - | - | - |
| Oct.(89&90) | 7 | 1 | 0.14 | 3 | 3.0 | 0.42 |
| Nov.(89&90) | - | - | - | - | - | - |
| Dec.(89&90) | 3 | 0 | 0 | 0 | 0 | 0 |
| Jan.(90&91) | 1 | 0 | 0 | 0 | 0 | 0 |

TABLE NO. 18-B

BODY WEIGHT OF THE HOST 101-150 g.

| Month/ Year | Number of hosts Examined | Number of hosts Infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| Feb. (89&90) | 3 | 0 | 0 | 0 | 0 | 0 |
| March (89&90) | 4 | 1 | 0.25 | 2 | 2.0 | 0.5 |
| April (89&90) | 2 | 0 | 0 | 0 | 0 | 0 |
| May (89&90) | 5 | 0 | 0 | 0 | 0 | 0 |
| June (89&90) | 6 | 0 | 0 | 0 | 0 | 0 |
| July (89&90) | 7 | 0 | 0 | 0 | 0 | 0 |
| Aug.(89&90) | - | - | - | - | - | - |
| Sep.(89&90) | 1 | 0 | 0 | 0 | 0 | 0 |
| Oct.(89&90) | - | - | - | - | - | - |
| Nov.(89&90) | 3 | 0 | 0 | 0 | 0 | 0 |
| Dec.(89&90) | 2 | 0 | 0 | 0 | 0 | 0 |
| Jan.(90&91) | 3 | 0 | 0 | 0 | 0 | 0 |

TABLE NO. 18-C

BODY WEIGHT OF THE HOST 151-200 g.

| Month/ Year | Number of hosts Examined | Number of hosts Infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| Feb. (89&90) | 4 | 1 | 0.25 | 1 | 1.0 | 0.25 |
| March (89&90) | 3 | 2 | 0.66 | 6 | 3.0 | 2.0 |
| April (89&90) | 1 | 1 | 1.0 | 1 | 1.0 | 1.0 |
| May (89&90) | - | - | - | - | - | - |
| June (89&90) | 1 | 0 | 0 | 0 | 0 | 0 |
| July (89&90) | 1 | 0 | 0 | 0 | 0 | 0 |
| Aug. (89&90) | - | - | - | - | - | - |
| Sep. (89&90) | 1 | 0 | 0 | 0 | 0 | 0 |
| Oct. (89&90) | - | - | - | - | - | - |
| Nov. (89&90) | 3 | 0 | 0 | 0 | 0 | 0 |
| Dec. (89&90) | - | - | - | - | - | - |
| Jan. (90&91) | 3 | 0 | 0 | 0 | 0 | 0 |

TABLE NO. 18-D

BODY WEIGHT OF THE HOST 201-250 g.

| Month/ Year | Number of hosts Examined | Number of hosts Infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| Feb. (89&90) | 2 | 0 | 0 | 0 | 0 | 0 |
| March (89&90) | 3 | 1 | 0.33 | 4 | 4.0 | 1.3 |
| April (89&90) | 3 | 1 | 0.33 | 2 | 2.0 | 0.66 |
| May (89&90) | 5 | 1 | 0.2 | 2 | 2.0 | 0.4 |
| June (89&90) | 2 | 0 | 0 | 0 | 0 | 0 |
| July (89&90) | 2 | 0 | 0 | 0 | 0 | 0 |
| Aug. (89&90) | 2 | 0 | 0 | 0 | 0 | 0 |
| Sep. (89&90) | 1 | 1 | 1.0 | 1 | 1.0 | 1.0 |
| Oct. (89&90) | - | - | - | - | - | - |
| Nov. (89&90) | 2 | 1 | 0.5 | 2 | 2.0 | 1.0 |
| Dec. (89&90) | 2 | 0 | 0 | 0 | 0 | 0 |
| Jan. (90&91) | 3 | 0 | 0 | 0 | 0 | 0 |

TABLE NO. 19

AVERAGE ANNUAL VARIATIONS IN THE PREVALENCE, MEAN INTENSITY AND RELATIVE DENSITY OF CESTODE INFECTION IN RELATION TO THE SEX OF THE HOST.

| Sex | Number of hosts | | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| | Examined | Infected | | | | |
| Male | 55 | 4 | 0.072 | 7 | 1.75 | 0.127 |
| Female | 57 | 8 | 0.14 | 19 | 2.37 | 0.333 |

TABLE NO. 20 (A, B)

AVERAGE SEASONAL VARIATIONS IN THE PREVALENCE, MEAN INTENSITY AND RELATIVE DENSITY OF CESTODE INFECTION IN RELATION TO THE SEX OF HOST.

TABLE NO. 20-A

MALES

| Season | Number of hosts Examined | Number of hosts Infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| Winter | 18 | 0 | 0 | 0 | 0 | 0 |
| Summer | 24 | 4 | 0.166 | 7 | 1.75 | 0.291 |
| Rainy | 13 | 0 | 0 | 0 | 0 | 0 |

TABLE NO. 20-B

FEMALES

| Season | Number of hosts | | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| | Examined | Infected | | | | |
| Winter | 23 | 2 | 0.086 | 3 | 1.5 | 0.13 |
| Summer | 21 | 4 | 0.19 | 12 | 3.0 | 0.571 |
| Rainy | 13 | 2 | 0.153 | 4 | 2.0 | 0.307 |

TABLE NO. 21 (A, B)

AVERAGE MONTHWISE VARIATIONS IN THE PREVALENCE MEAN INTENSITY AND RELATIVE DENSITY OF CESTODE INFECTION IN RELATION TO THE SEX OF HOST.

TABLE NO. 21-A

MALES

| Month/ Year | Number of hosts Examined | Number of hosts Infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| Feb. (89&90) | 8 | 0 | 0 | 0 | 0 | 0 |
| March (89&90) | 11 | 2 | 0.18 | 4 | 2.0 | 0.36 |
| April (89&90) | 2 | 1 | 0.5 | 1 | 1.0 | 0.5 |
| May (89&90) | 7 | 1 | 0.14 | 2 | 2.0 | 0.28 |
| June (89&90) | 4 | 0 | 0 | 0 | 0 | 0 |
| July (89&90) | 6 | 0 | 0 | 0 | 0 | 0 |
| Aug. (89&90) | 1 | 0 | 0 | 0 | 0 | 0 |
| Sep. (89&90) | 2 | 0 | 0 | 0 | 0 | 0 |
| Oct. (89&90) | 4 | 0 | 0 | 0 | 0 | 0 |
| Nov. (89&90) | 3 | 0 | 0 | 0 | 0 | 0 |
| Dec. (89&90) | 2 | 0 | 0 | 0 | 0 | 0 |
| Jan. (90&91) | 6 | 0 | 0 | 0 | 0 | 0 |

TABLE NO. 21-B

**FEMALES**

| Month/ Year | Number of hosts Examined | Number of hosts Infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| Feb. (89&90) | 9 | 1 | 0.11 | 1 | 1.0 | 0.11 |
| March (89&90) | 5 | 3 | 0.6 | 10 | 3.33 | 2.0 |
| April (89&90) | 3 | 1 | 0.3 | 2 | 2.0 | 0.66 |
| May (89&90) | 6 | 0 | 0 | 0 | 0 | 0 |
| June (89&90) | 6 | 0 | 0 | 0 | 0 | 0 |
| July (89&90) | 8 | 0 | 0 | 0 | 0 | 0 |
| Aug. (89&90) | 1 | 0 | 0 | 0 | 0 | 0 |
| Sep. (89&90) | 1 | 1 | 1.0 | 1 | 1.0 | 1.0 |
| Oct. (89&90) | 3 | 1 | 0.33 | 3 | 3.0 | 1.0 |
| Nov. (89&90) | 5 | 1 | 0.2 | 2 | 2.0 | 0.4 |
| Dec. (89&90) | 5 | 0 | 0 | 0 | 0 | 0 |
| Jan. (90&91) | 4 | 0 | 0 | 0 | 0 | 0 |

TABLE NO. 22

AVERAGE ANNUAL VARIATIONS IN THE PREVALENCE, MEAN INTENSITY AND RELATIVE DENSITY OF CESTODE INFECTION IN RELATION TO THE CLOACAL TEMPERATURE OF THE HOST.

| Cloacal Temperature (˚F) | Number of hosts Examined | Number of hosts Infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| 70-77 | 17 | 0 | 0 | 0 | 0 | 0 |
| 78-85 | 53 | 10 | 0.18 | 23 | 2.3 | 0.43 |
| 86-93 | 18 | 2 | 0.11 | 3 | 1.5 | 0.17 |
| 94-101 | 24 | 0 | 0 | 0 | 0 | 0 |

TABLE NO. 23 (A, B, C, D)

AVERAGE SEASONAL VARIATIONS IN THE PREVALENCE, MEAN INTENSITY AND RELATIVE DENSITY OF CESTODE INFECTION IN RELATION TO THE CLOACAL TEMPERATURE OF THE HOST.

TABLE NO. 23-A

CLOACAL TEMPERATURE OF THE HOST-70-77`F

| Season | Number of hosts | | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| | Examined | Infected | | | | |
| Winter | 17 | 0 | 0 | 0 | 0 | 0 |
| Summer | - | - | - | - | - | - |
| Rainy | - | - | - | - | - | - |

TABLE NO. 23-B

CLOACAL TEMPERATURE OF THE HOST-78-85`F

| Season | Number of hosts | | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| | Examined | Infected | | | | |
| Winter | 24 | 2 | 0.08 | 3 | 1.5 | 0.12 |
| Summer | 22 | 7 | 0.32 | 17 | 2.43 | 0.77 |
| Rainy | 7 | 1 | 0.14 | 3 | 3.0 | 0.43 |

TABLE NO. 23-C

CLOACAL TEMPERATURE OF THE HOST 86-93`F

| Season | Number of hosts | | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| | Examined | Infected | | | | |
| Winter | - | - | - | - | - | - |
| Summer | 13 | 1 | 0.078 | 2 | 2.0 | 0.15 |
| Rainy | 5 | 1 | 0.2 | 1 | 1.0 | 0.2 |

## TABLE NO. 23-D

### CLOACAL TEMPERATURE OF THE HOST 93-101`F

| Season | Number of hosts | | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| | Examined | Infected | | | | |
| Winter | - | - | - | - | - | - |
| Summer | 10 | 0 | 0 | 0 | 0 | 0 |
| Rainy | 14 | 0 | 0 | 0 | 0 | 0 |

TABLE NO. 24 (A, B, C, D)

AVERAGE MONTHWISE VARIATIONS IN THE PREVALENCE, MEAN INTENSITY AND RELATIVE DENSITY OF CESTODE INFECTION IN RELATION TO THE CLOACAL TEMPERATURE OF THE HOST.

TABLE NO. 24-A

CLOACAL TEMPERATURE OF THE HOST-70-77`F

| Month/ Year | Number of hosts Examined | Number of hosts Infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| Feb. (89&90) | - | - | - | - | - | - |
| March (89&90) | - | - | - | - | - | - |
| April (89&90) | - | - | - | - | - | - |
| May (89&90) | - | - | - | - | - | - |
| June (89&90) | - | - | - | - | - | - |
| July (89&90) | - | - | - | - | - | - |
| Aug. (89&90) | - | - | - | - | - | - |
| Sep. (89&90) | - | - | - | - | - | - |
| Oct. (89&90) | - | - | - | - | - | - |
| Nov. (89&90) | - | - | - | - | - | - |
| Dec. (89&90) | 7 | 0 | 0 | 0 | 0 | 0 |
| Jan. (90&91) | 10 | 0 | 0 | 0 | 0 | 0 |

TABLE NO. 24-B

CLOACAL TEMPERATURE OF THE HOST-78-85`F

| Month/ Year | Number of hosts | | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| | Examined | Infected | | | | |
| Feb. (89&90) | 16 | 1 | 0.062 | 1 | 1.0 | 0.062 |
| March (89&90) | 16 | 5 | 0.312 | 14 | 2.8 | 0.875 |
| April (89&90) | 6 | 2 | 0.333 | 3 | 1.5 | 0.5 |
| May (89&90) | - | - | - | - | - | - |
| June (89&90) | - | - | - | - | - | - |
| July (89&90) | - | - | - | - | - | - |
| Aug. (89&90) | - | - | - | - | - | - |
| Sep. (89&90) | - | - | - | - | - | - |
| Oct. (89&90) | 7 | 1 | 0.142 | 3 | 3.0 | 0.428 |
| Nov. (89&90) | 8 | 1 | 0.125 | 2 | 2.0 | 0.25 |
| Dec. (89&90) | - | - | - | - | - | - |
| Jan. (90&91) | - | - | - | - | - | - |

TABLE NO. 24-C

CLOACAL TEMPERATURE OF THE HOST 86-93`F

| Month/ Year | Number of hosts | | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| | Examined | Infected | | | | |
| Feb. (89&90) | - | - | - | - | - | - |
| March (89&90) | - | - | - | - | - | - |
| April (89&90) | - | - | - | - | - | - |
| May (89&90) | 13 | 1 | 0.076 | 2 | 2.0 | 0.153 |
| June (89&90) | - | - | - | - | - | - |
| July (89&90) | - | - | - | - | - | - |
| Aug. (89&90) | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep. (89&90) | 3 | 1 | 0.333 | 1 | 1.0 | 0.333 |
| Oct. (89&90) | - | - | - | - | - | - |
| Nov. (89&90) | - | - | - | - | - | - |
| Dec. (89&90) | - | - | - | - | - | - |
| Jan. (90&91) | - | - | - | - | - | - |

TABLE NO. 24-D

CLOACAL TEMPERATURE OF THE HOST 94-101`F

| Month/ Year | Number of hosts Examined | Infected | Prevalence | Number of cestodes obtained | Mean intensity | Relative density |
|---|---|---|---|---|---|---|
| Feb. (89&90) | - | - | - | - | - | - |
| March (89&90) | - | - | - | - | - | - |
| April (89&90) | - | - | - | - | - | - |
| May (89&90) | - | - | - | - | - | - |
| June (89&90) | 10 | 0 | 0 | 0 | 0 | 0 |
| July (89&90) | 14 | 0 | 0 | 0 | 0 | 0 |
| Aug. (89&90) | - | - | - | - | - | - |
| Sep. (89&90) | - | - | - | - | - | - |
| Oct. (89&90) | - | - | - | - | - | - |
| Nov. (89&90) | - | - | - | - | - | - |
| Dec. (89&90) | - | - | - | - | - | - |
| Jan. (90&91) | - | - | - | - | - | - |

# PART-D

# BIBLIOGRAPHY


| | | |
|---|---|---|
| Agarwal, N. and Singh, H.S. | 1985 | Cestode fauna of 1-6 on a rare cestode district Gorakhpur, *Capingentoides gorakhnathai* (n.sp.) Ind. J. Hel. (n.s.) Vol. 2. Nos. (1 & 2), 81-84. |
| Alexander, C.G. | 1953 | Tetraphyllidean cestodes from the eastern Pacific. J.Par. 39(4) Sect 2, suppl,28-29. |
| Amin, O.M. | 1986 | Acanthocephala from lake fishes Wisconsin. Host and seasonal distribution of species of the genus *Neoechinorhychus* Hamann, 1892. J. Parasitol. 72(1) : 11-118. |
| Beneden, P.J.Van. | 1850 | Recherches sur la faune littorale de Belgique, les vers cestodes. Mem. Acad. Roy. Sc. Belg. 25, 1-4. |
| Brooks, D.R. *et* Deardorff, T.L. | 1980 | Three Proteocephalid cestodes from columbian siluroid fishes including *Nomimoscolex alovarius* |

sp.n. (Monticelliidae:Zygobothriinae). Proc. Helminthol Soc. Wash. 47, 15-21.

Chauhan, R.S. and Malhotra, S.K. *et. al.* 1981 An analysis of parasitization index and certain ecological parameters of cestode parasites infesting in hill stream fishes of district Pauri-Garahwal. U.P.India. Sc.& environment 3(1), 47-56.

Chincholikar, L.N. and Shinde, G.B. 1977 On a new sp.of *Circumoncobothrium* cestoda : Pseudopyllidea from a fresh water fish in India. Marathwada Uni. J. Sci. 16(9), 183-186.

Chubb, J.C. 1977 Seasonal occurence of helminths in fresh water fishes.I.Monogenea Advances in parasitology. 15, 133-199.

Crowcroft, P.W. 1947 Note on *Anthobothrium hickmani*, a new cestode from the Tasmanian electric ray (*Narcine*

*tasmaniensis* Rechardson). Pap. Proc. R. Soc. Tasmania (1946), 1-4.

Diesing, K.M. 1863 Revesion der cephalocotyleen abtheilung paramecocotyleen. Sitzungber. Akad. Wiss. Wien. Math. Naturwiss Kl. Abt. I 48, 200-345.

Dixit, S. and Capoor, V.N. 1980 Incidence of cestode infection in reptiles in relation with temperature in district Allahabad. Sci. Envir. 2(2), 95-100.

Dogiel, V.A. 1961 Ecology of the parasites of fresh water fishes. In parasitology of fishes. Oliver and Boyd. Edinburgh and London, 1-47.

Dollfus, R.Ph. 1934 Sur une larve de Tetrarhynque enkystee chez un *Dentex macrophthalmus* Cuv., Travaux publies par la station d' Aquiculture et de peche de castiglione. Annee 1932 & 2 me fasc., 125-133.

Esch, G.W. 1983 The population and community ecology of cestodes. In biology of Eucestoda, Vol 1(ed. Arme. C & Pappas, P.W.) 81-137 London. Academic press.

Eure, H. 1976 Seasonal abundance of *Neoechinorhynchus cylindratus* taken from large mouth bass (*Micropterus salmoides*) in a heated reservoir.
Parasitology, 73, 355-370.

Fotedar, D.N. and Dhar, R.L. 1974 *Gangesia (Vermaia) jammuensis* n.sp.(Proteocephalidae : cestoda) from fresh water fish in Jammu, India.
Proc. Ind. Sci. Congr. Assoc. 61(Abstr.). 68.

Freze, V.I. 1969 Essentials of cestodology Vol.V Edited by Academician K.I. Skrjabin. Proteocephalata in fishes, Amphibians and Reptiles. Isarael Program for Scientific translation, 1-597.

Fuhrmann, O. and Baer, J.G. 1925 Zoological result of the third Tanganyika expedition, conducted by W.A. Cunnington, 1904-1905. 1, 79-100.

Granath, W.O.J. and Gerald, W.E. 1983 Temperature and other factors that regulate the composition and infrapopulation densition of *Bothriocephalum achcilognath* (Cestoda) in *Gambusia affinis*. J.Parasitol. 69(6). 1116-1124.

Guiart, J. 1935 Le veritable *Floriceps saccatus* de Cuvier n'est pas la larve geant de tetrarhynque vivant dans le fole du more (Mola mola). Bull. Inst. oceanogr. Monaco, No. 666, 1-15.

Gupta, S.P. 1961 Caryophyllaeids (Cestoda) from fresh water fishes of India. Proc. Helminthol. Soc. Wash. 28, 38-50.

Gupta, S.P. and Sinha, N. 1980 Two new species of *Senga* Dollfus, 1934 (Cestoda : Ptychobothriidae) from fresh water fishes of Lucknow.

Ind. J. Helm. Vol. XXX11 No.2, 124-128.

Gupta, V. and Parmar, S. 1982-A On a new cestoda, *Gangesia (Gangesia) indica* sp. nov. from a fresh water fish *Wallagonia attu* (Bloch.) from Lucknow, U.P. Ind. J. Helm. Vol. XXXIV Nol, 44-49.

Gupta, V. and Parmar, S. 1982-B On a new Caryophyllaeid *Pseudocaryophyllaeus mackiewiczi* sp. nov. from the intestine of a fresh water fish, *Heteropneustes fossilis* (Ham.) from Gorakhpur, U.P. Ind. J. Helm. Vol. XXXIV No. 1, 136-138.

Gupta, V. and Parmar, S. 1985-A Cestode parasite of vertebrates *Capingentoides fotedari* sp. n. from a fresh water fish *Clarius batrachus* (L.) from Lucknow. Ind. J. Helm. Vol. XXXVII No.1 , 31-35.

Gupta, V. and Parmar, S. 1985-B On a new cestode, *Senga indica* sp. nov. from the intestine of a

| | | |
|---|---|---|
| | | fresh water fish. *Mastacembelus armatus* (Lacp.) from Lucknow. Ind. J. Helm. Vol. XXXVII No. 2, 96-99. |
| Gupta, V. and Parmar, S. | 1990 | On two caryophyllaeids from river Gomti, Lucknow, Uttar Pradesh. Ind. J. Helm. Vol. XXXXII No.1, 25-30. |
| Gupta, V. and Singh, S.R. | 1983 | On a new sp. *Pseudocaryophyllaeus ritai* sp. nov. (Family : Caryophyllaeidae) from the intestine of fresh water fish *Rita rita* from river Gomti at Lucknow. Ind. J. Helm. Vol. XXXIV, No. 1, 11-14. |
| Hunter, G.W., III | 1927-A | Notes on Caryophyllaeidae of North America. J. Parasitol. 14, 16-26. |
| Hunter, G.W., III | 1927-B | Studies on the Caryophyllaeidae of North America. III. Biol. Monogr. II 1-186. |
| Hunter, G.W. III | 1929 | New Caryophyllaeidae from North America. |

J. Parasitol. 15, 185-192.

Jadhav, B.V. and Shinde, G.B. 1980 A new cestode, *Senga aurangabadensis* new sp. from the fish *Mastacembelus armatus*. Bioresearch (Ujjain) 4(2), 25-27.

Jha, A.N. and Sinha, P. 1990 The occurence of helminth parasites in relation to the size of fish. Biojournal Vol. 2 No. 2, 311-316.

Kadam, S.S., Jadhav, B.V. and Shinde, G.B. 1981 *Senga paithansis* n.sp. (Cestoda : Ptychobothriidae) from *Mastacembellus armatus*. Bioresearch. 5(1), 95-96.

Kazic, D. and Ubelakar, J. *et.al*. 1977 Observation and seasonal variation of the helminth fauna of *Gobio gobio lapidolaemus* (Kessler 1872) (Cyprinidueliseus) from lake Skadar Yugoslavia. Glas. Repub. Zavoda Zast. prir. prir. Muz. Tstogradu (10), 5-30.

Kearn, G.C. 1986 The eggs of Monogeneans. Advances in Parasitology, 25, 175-273.

| | | |
|---|---|---|
| Kennedy, C.R. | 1969 | Seasonal incidence and development of cestode *Caryophylleus laticeps* in the river Avon. Parasit. 59, 783-794. |
| Kinsella, J.M. | 1966 | Helminth fauna of Florida, Scrub Jay : Host and ecological relationships. Proc. Helm. Soc. Wash. LXIV. |
| Lees, E. | 1962 | The incidence of helminth parasites in a perticular frog population. Parasitology. 52, 95-102. |
| Linton, E. | 1890 | Notes on Entozoa of marine fishes of New England. II, Annu. Rep. U.S. Comm. Fish fish. 1887 Vol. 15. Washington, D.C., 719-899. |
| Mackiewicz, J.S. *et* Beverley-Burton, M. | 1967 | *Monobothrioides woodlandi* sp.nov. (Cestoidea : Caryophyllidea) from *Clarius mellandi* Boulenger (Cypriniformes : Clariidae) in Zambia. |

| | | |
|---|---|---|
| | | Africa Proc. Helminthol. Soc. Wash. 34, 125-128. |
| Majid, M.A. and Shinde, G.B. | 1984 | Two new species of the genus *Senga* Dollfus, 1934 (Cestoda : Pseudophyllidea) from fresh water fishes at Jagannathpuri, Orissa. Ind. J. Parasit. 8(1), 169-172. |
| Malhotra, S.K. | 1988 | Cestode fauna of Hill stream fishes in Garhwal himalayas. India VI. *Senga nayari* sp. nov. form *Mastacembellus armatus.* Ind. J. Helm. Vol. No. XXXX No.1, 53-57. |
| Malhotra, S.K. | 1992 | Interrelationship of *Heterakis pavonis* infection in poultry of an Indian sub humid region with season, temperature and host sex. J. Parasit. Appl. Anim. Biol. Vol. 1 No. 1, 77-89. |
| Malhotra, S.K. Capoor, V.N. and Shinde, G.B. | 1980 | Introduction of a taxonometric device to evaluate a new Proteocephalid cestode *Gangesia sanehensis* n.sp. from fresh water fishes of Garhwal, himalayas with |

a revised key to species of genus *Gangesia*.
Marathwada Univ. J. Vol. No. XIX Sci. 12.

Malhotra, S.K. and Capoor, V.N. 1982 Mathematical models of helmintho-coenoses in poultry of a sub humid region.
Geobios New Reports 80, 11-15.

Malhotra, S.K. and Capoor, V.N. 1984 Population structure of nematode parasites in poultry of a sub humid region.
Comp. Physiol. Ecol. 9(1), 129-132.

Malhotra, S.K., Capoor, V.N., Bhalya, A. and Seth, A. 1982 Influence of sex and weight of poultry on *Heterakis gallinarm* infection in sub-humid region.
Bulletin pure and Applied Sci. 1, 133-139.

Malhotra, S.K. and Chauhan, R.S. 1984 Distribution of cestodes in the digestive tract of Indian hill stream fishes.
Korean J. Parasitol. 22(2), 238-241.

| | | |
|---|---|---|
| Malhotra, S.K. Chauhan, R.S. and Capoor, V.N. | 1980 | Nematode infection in relation to some ecological aspects of hill stream fishes. Geobios, 7, 193-198. |
| Malhotra, S.K. Chauhan, R.S. and Capoor, V.N. | 1981 | Statistical analysis of Nematode infection in relation to some ecological aspects of fishes in Garhwal Himalayas, India. J. Environ. Res. 2(1), 18-28. |
| Malhotra, S.K. and Dixit, S. *et al* | 1981 | Taxometric evaluation of a new fish cestode *Gangesia mehamdabadensis* n.sp. from *Mystus tengra* from Mehamdabad, Gujrat. Sci. and Environment. 3(1), 7-11. |
| Margolis, L. *et al* | 1982 | The use of ecological terms in parasitology (Report of an adhoc committee of the American Society of parasitologists). J. Parasit. 68(1), 131-133. |
| Markov, G.S. and Rogoza, M.L. | 1955 | Annual differences in the parasitic fauna of grass frogs (*Rana temporaria*). Zool. Zh. 34, 1203-1209. (In Russian). |

Mazuromovich, B.N. 1951 Parasitic worm of Amphibia. Klev. Kiev. University Press. (In Russian).

Moghe, M.A. 1925-A *Caryophyllaeus indicus* n.sp. from the cat fish (*Clarius batrachus*). Parasit. 17, 232-235.

Moghe, M.A. 1925-B Two new cestodes from Indian Columbidae. Rec. Ind. Mus. Vol.17, 53-60.

Murhar, B.M. 1964 *Crescentovitus biloculus* gen. nov., sp.nov. a fish cestode (Caryophyllaeidae) from Nagpur, India. Parasitology, 53, 413-418.

Mutafova, T. 1976 Khril minthologia 1, 69-77.

Pandey, K.C. 1977 Studies on some cestodes from fishes, birds and mammals. Ind. J. Zootomy 14(3), 221-226.

Pandey, G.P. 1983 Morphology, Taxonomy and ecology of cestodes parasites of vertebrates. Ph.D. Thesis, Kanpur University, Kanpur.

| | | |
|---|---|---|
| Poche, F. | 1922 | Zur kenntnis der Amphilinidea. Zool. Anz. 54, 276-287. |
| Ramadevi, P. and Rao, H. | 1973 | On *Senga vishakhapatnamensis* n.sp. (cestoda : Pseudophyllidea) from the intestine of the fresh water fish *Ophiocephalus punctatus*. Riv. parasitol. 34, 281-286. |
| Rego, A.A., Santos,J.C. and Silva, P.P. | 1974 | Estudos de cestoides de peixes do Brasil. Mem. Inst. O. Cruz. 72, 184-204. |
| Rehana, R. *et* Bilquees, F.M. | 1971 | *Gangesia shindensis* new species (Cestoda : Proteocephalidae) from the fish *Wallago attu* of Kalri lake, Sind, West Pakistan. J. Zool. 3, 217-219. |
| Roitman, V.A. and Freze, V.I. | 1964 | New species of *Gangesia* (Cestoda: Proteocephalata) from fish from the Amur basin.(In Russian). Tr. Gel'mintol lab. 14, 170-181. |
| Saberwal, A. Malhotra, S.K. and Capoor, V.N. | 1992 | Ecological dynamics of Proteocephalid infections in *Wallago attu* at Allahabad. |

J. Parasit. Appl. Biol. Vol. 1 No. 1, 63-70.

Saoud, M.F.A. 1963 On a new cestode, *Anthobothrium taeniuri* n.sp. (Tetraphyllidea) from the Red Sea sting ray and the relationship between *Anthobothrium* Van Beneden, 1850. *Rhabdobothrium* Linton, 1889 and *Inermiphyllidium* Riser, 1955. J. Helminthol. 37, 135-144.

Schmidt, G.D. 1986 C.R.C. Hand book of Tape Worm identification. C.R.C. Press, Inc. Boca Raton, Florida, 1-675.

Shinde, G.B. 1968 On *Circumoncobothrium ophiocephali* n.gen., n.sp. from a fresh water fish (*Ophicephalus leucopunctatus*) in India. Riv. Parasitol. 29, 111-114.

Shinde, G.B. 1977 On a new species of *Circumoncobothrium* Shinde, 1968 (Cestoda : Pseudophyllidea) from a fresh water fish in India.

| | | |
|---|---|---|
| | | Marathwada Univ. J. Sci. 16(9), 129-132. |
| Shinde, G.B. and Chincholikar, L.N. | 1977 | On a new species of *Circumoncobothrium* Shinde, 1968 (Cestoda : Pseudophyllidea) from a fresh water fish in India. Natural Sci. J. Vol. XVI Sci. 9. |
| Shinde, G.B. and Deshmukh, R.A. | 1980 | On *Senga khami* n.sp. (Cestoda : Ptycobothriidae) from a fresh water fish. Ind. J. Zool. Vol. 8 No.1, 29-33. |
| Shinde, G.B. and Jadhav, B.V. | 1976 | New species of the genus *Circumoncobothrium* Shinde, 1968 (Cestoda : Pseudophyllidea) form a fresh water fish from Marathwada, India. Marathwada Univ. J. Sci. 15(8), 269-272. |
| Shinde, G.B. and Jadhav, B.V. | 1980 | A new tape worm, *Senga godavarii* new sp. from the fish *Mastacembellus armatus* at Aurangabad, India. Biology 11, 46-48. |

| | | |
|---|---|---|
| Shinde, G.B., Jadhav, B.V. and Mohekar, A.D. | 1981 | *Anthobothrium veravalensis* sp. nov. (Cestoda : Tetraphyllidea) from *Rhynchobatus djiddensis* (Forsk) of Veraval, West coast. Ind. J. Parasitol, 5, 107-108. |
| Shipley, A.E. | 1900 | Entozoa, Fauna Hawaiiensis, 2, 427-441. |
| Singh, K.S. | 1948 | On a new cestode, *Gangesia lucknowia* (Proteocephalidea) from fresh water fish, *Entropiichthys vacha* Day, with a revised Key to the species of the genus. Ind. J. Helm. 2, 41-46. |
| Southwell, T. | 1911 | Discription of nine new species of cestode parasite including two new genera from marine fishes of Ceylon. Ceylon Mar. Biol. Rep. PartV, 216-225. |
| Southwell, T. | 1925 | A monograph on the Tetraphyllidea with notes on related cestodes. Liver Pl. Sch. Trop. Med.Mem. (n.s.) No. 2, 1-368. |

Southwell, T. 1930 The fauna of British India including Ceylon and Burma. Vol. 1, Taylor & Frances, London.

Srivastav, A.K. and Capoor, V.N. 1980 On a new species of *Anthobothrium* Van Beneden, 1850 from *Scolidon sorrakowah*. Sci. & Enviornment, 2(1), 33-34.

Srivastav, A.K. and Srivastava, B.K. 1988 On a new cestode *Anthobothrium sasoonense* sp.n.(Phyllobothridae: Cestoda) from the elasmobranch fish *Rhinobatus granulatus* from Sasoon dock, Bombay, India. Helminthologia 25, 15-20.

Srivastav, A.N. 1987 Studies on the morphology, taxonomy and ecology of cestode parasites of vertebrates. Ph.D. Thesis, Avadh University Faizabad.

Srivastava, B.K. 1989 Study of avian cestode parasites and ecological observation of fowls in Jhansi. Ph.D. Thesis Bundelkhand University, Jhansi.

Stossich, M. 1895 Notizie elmintologiche. Boll. Soc. Adriat. Sci. Nat. Trieste. 16, 33-46.

Subhapradha, C.K. 1957 Cestode parasites of fishes of Madras coast. Ind. J. Helm.7(2) (1955), 41-132.

Thomas, J.D. 1964 A comparison between the helminth burdens of male and female brown trout *Salmo trutta* L., from a natural population in the river Teify, West Wales. Parasit. 54, 263-272.

Tochque, K. and Tinsley, R.C. 1991 The influence of desert temperature cycles on the reproductive biology of *Pseudodiplorchis americanus* (Monogenea). Parasitology 103, 111-120.

Troncy, P.M. 1978 Nouvelles observations sur les parasites des poissoms du bassin tchadien. Bull. Inst. Fondamental Afr. Noire, 40, 528-552.

Verma, S.C. 1928 Some cestodes from Indian fishes including four new species from Tetraphyllidea and revised keys of the genera *Acanthobothrium* and *Gangesia*.
Allahabad Univ. Studies 4, 119-176.

Verma, S.L. 1971 Helminth parasites of fresh water fishes part 1. On two Caryophyllaeids from fresh water fishes of Lucknow.
Ind. J. Helm. Vol. XXIII No. 1, 71-80.

Wardle, R.A. and McLeod, J.A. 1852 The Zoology of tape worms.
Hafner publishing company New York and London, 1-780.

Williams, H.H. 1964 Some new and little known cestodes from Australian elasmobranchs with a brief discussion on their possible use in problems of host taxonomy.
Parasitology, 54, 737-748.

Woodland, W.N.F. 1923-A On some remarkable new forms of

| | | |
|---|---|---|
| | | Caryophyllaeidae from the Anglo Egyptian Sudan and a revision of the families of the cestodaria. Q. J. Microsc. Sci. 67, 435-472. |
| Woodland, W.N.F. | 1923-B | On *Amphilina paragonopora* sp. n. and a hitherto undescribed phase in the life history of the genus. Q. J. Microsc. Sci. 67, 47-84. |
| Woodland, W.N.F. | 1924 | On a new Bothriocephalus and a new genus of Proteocephalidae from Indian fresh water fishes Parasitology, 16, 441-451. |
| Woodland, W.N.F. | 1933 | On two new cestodes from the Amazon siluroid fish *Brachyplatystoma vaillanti*. Cuv. Parasit. 25, 485-490. |
| Woodland, W.N.F. | 1934-A | On some remarkable new cestodes from the Amazon siluroid fish, *Brachyplatystoma filamentosum* (Lichtenstein). Parasitology, 26, 268-277. |
| Woodland, W.N.F. | 1934-B | On six new cestodes from Amazon fishes. Proc. Zool. Soc. London, 33-44. |

| | | |
|---|---|---|
| Woodland, W.N.F. | 1935-A | Some more remarkable cestodes from Amazon siluroid fish. Parasitology, 27, 207-225. |
| Woodland, W.N.F. | 1935-B | Additional cestodes from the Amazon siluroids, Pirarara, Dorad and Sudobim. Proc. Zool. Soc. London., 851-862. |
| Woodland, W.N.F. | 1935-C | Some new Proteocephalids and Ptychobothriid (Cestoda) from the Amazon. Proc. Zool. Soc. London, 619-623. |
| Woodland, W.N.F. | 1937 | Some cestodes from sierra leone I. On *Wenyonia longicauda* sp.n. and *Proteocephalus bivitellatus* sp.n. Proc. Zool. Soc. London, 931-937. |
| Yamaguti, S. | 1934 | Studies on the helminth fauna of Japan. IV cestodes of fishes. Jpn. J. Zool. 6, 1-112. |
| Yamaguti, S. | 1952 | Studies on the helminth fauna of Japan XLIX cestodes of fishes II. Acta. Med. Okayama, 8, 1-78. |

| | | |
|---|---|---|
| Yamaguti, S. | 1959 | Systema helminthum, Vol. II The cestodes of vertebrates. Interscience Publishers Inc. New York, 1-860. |
| Young, R.T. | 1954 | Cestodes of Sharks and Rays in Southern California. Proc. Helminthol. Soc. Wash., 21, 106-112. |
| Zaidi, D.A. and Khan,D. | 1976 | Cestodes of fishes from Pakistan. Biologia, 22, 157-179. |

## EXPLANATION OF PLATES

Plate 1. *Gigantolina (Unilobulata) raebareliensis* n.subg.,n.sp.

Fig. 1. Apical part showing gland cells (5x5)

Fig. 2. Posterior region of the body (5x5)

Plate 2. *Monobothrioides woodlandi* Mackiewicz and Beverley Burton, 1967

Fig. 1. Scolex with neck (5x10)

Fig. 2. Middle region of the body (5x10)

Fig. 3. Transverse section (A portion through testes and vitellaria) (5x45)

Fig. 4. Posterior region of body (5x10)

Plate 3. *Bilobulata georgievi* n.g., n.sp.

Fig. 1. Scolex with neck (5x10)

Fig. 2. Middle region of the body (5x10)

Fig. 3. Transverse section (A portion through testes and vitellaria) (5x10)

Fig. 4. Posterior region of body (5x10)

Plate 4. *Mystoides bundelkhandensis* n.g., n.sp.

Fig. 1. Scolex (5x5)

Fig. 2. Posterior region of the body (5x5)

Fig. 3. Middle region of the body (5x10)

Fig. 4. Eggs (5x10)

Plate 5. *Pseudolytocestus dayali* n.sp.

Fig. 1. Scolex (5x10)

Fig. 2. Middle region of the body (5x10)

Fig. 3. Posterior region of the body (5x5)

Fig. 4. Eggs (5x10)

Plate 6. *Pseudolytocestus pandei* n.sp.

Fig. 1. Scolex with neck (5x10)

Fig. 2. Posterior region of the body (5x10)

Fig. 3. Transverse section (A portion through testes and vitellaria) (5x45)

Plate 7. *Pseudoadenoscolex fossilis* n.g., n.sp.

Fig. 1. Anterior portion of the body (5x5)

Fig. 2. Middle portion of the body (5x5)

Fig. 3. Posterior portion of the body (5x5)

Plate 8. *Circumoncobothrium capoori* n.sp.

Fig. 1. Scolex (5x10)

Fig. 2. Hooks (5x45)

Fig. 3. Mature proglottid (5x10)

Fig. 4. Gravid proglottid (5x10)

Fig. 5. Eggs (5x45)

Plate 9. *Senga jhansiensis* n.sp.

Fig. 1. Scolex (5x10)

Fig. 2. Hooks (5x45)

Fig. 3. Mature proglottid (5x10)

Fig. 4. Gravid proglottid (5x10)

Plate 10. *Anthobothrium blochii* n.sp.

Fig. 1. Scolex with neck (10x10)

Fig. 2. Mature proglottid (10x10)

Fig. 3. Gravid proglottid (5x10)

Plate 11. *Anthobothrium puriensis* n.sp.

Fig. 1. Scolex (10x10)

Fig. 2. Mature proglottid (10x10)

Plate 12. *Anthobothrium srivastavai* n.sp.

Fig. 1. Scolex (5x10)

Fig. 2. Mature proglottid (5x10)

Fig. 3. Mature proglottid (Posterior half) (5x45)

Plate 13. *Gangesia chauhani* n.sp.

Fig. 1. Scolex with neck (5x10)

Fig. 2. Mature proglottid (5x10)

Fig. 3. Mature proglottid showing cirrus (5x10)

Fig. 4. Gravid proglottid (10x10)

Fig. 5. Hook (5x45)

Fig. 6. Egg (5x45)

Plate 14. *Nomimoscolex shrotrii* n.sp.

Fig. 1. Scolex (5x10)

Fig. 2. Mature proglottid (5x10)

Fig. 3. Gravid proglottid (5x10)

Fig. 4. Transverse section of gravid proglottid (5x10)

Fig. 5. Egg (5x45)

Variations in the helminth infection in singhi fish.

Plate 15.

Fig. 1. Average annual prevalence

Fig. 2. Average annual mean intensity

Plate 16.

Fig. 3. Average annual relative density

Variations in prevalence, mean intensity and relative density of cestode infection in singhi fish.

Plate 17.

Fig. 1. Average seasonal prevalence

Fig. 2. Average seasonal mean intensity

Plate 18.

Fig. 3. Average seasonal relative density

Plate 19.

Fig. 1. Average monthwise prevalence

Fig. 2. Average monthwise mean intensity

Plate 20.

Fig. 3. Average monthwise relative density

Variations in the prevalence, mean intensity and relative density of cestode infection in relation to the body weight of the singhi fish.

Plate 21.

Fig. 1. Average annual prevalence

Fig. 2. Average annual mean intensity

Plate 22.

Fig. 3. Average annual relative density

Plate 23.

Fig. 1. Average winter prevalence

Fig. 2. Average summer prevalence

Plate 24.

Fig. 3. Average rainy prevalence

Plate 25.

Fig. 1. Average winter mean intensity

Fig. 2. Average summer mean intensity

Plate 26.

Fig. 3. Average rainy mean intensity

Plate 27.

Fig. 1. Average winter relative density

Fig. 2. Average summer relative density

Plate 28.

Fig. 3 Average rainy relative density

Plate 29.

Fig. 1. Average monthwise prevalence in 51-100g.

Fig. 2. Average monthwise mean intensity in 51-100g.

Plate 30.

Fig. 3. Average monthwise relative density in 51-100g.

Plate 31.

Fig. 1. Average monthwise prevalence in 101-150g.

Fig. 2. Average monthwise mean intensity in 101-150g.

Plate 32.

Fig. 3. Average monthwise relative density in 101-150g.

Plate 33.

Fig. 1. Average monthwise prevalence in 151-200g.

Fig. 2. Average monthwise mean intensity in 151-200g.

Plate 34.

Fig. 3. Average monthwise relative density in 151-200g.

Plate 35.

Fig. 1. Average monthwise prevalence in 201-250g.

Fig. 2. Average monthwise mean intensity in 201-250g.

Plate 36.

Fig. 3. Average monthwise relative density in 201-250g.

Variations in the prevalence, mean intensity and relative density of cestode infection in relation to the sex of the host.

Plate 37.

Fig. 1. Average annual prevalence

Fig. 2. Average annual mean intensity

Plate 38.

Fig. 3. Average annual relative density

Plate 39.

Fig. 1. Average seasonal prevalence

Fig. 2. Average seasonal mean intensity

Plate 40.

Fig. 3. Average seasonal relative density

Plate 41.

Fig. 1. Average monthwise prevalence in male

Fig. 2. Average monthwise mean intensity in male

Plate 42.

Fig. 3. Average monthwise relative density in male

Plate 43.

Fig. 1. Average monthwise prevalence in female

Fig. 2. Average monthwise mean intensity in female

Plate 44.

Fig. 3. Average monthwise relative density in female

Variations in the prevalence mean intensity and relative density of cestode infection in relation to the cloacal temperature of the host.

Plate 45.

Fig. 1. Average annual prevalence

Fig. 2. Average annual mean intensity

Plate 46.

Fig. 3. Average annual relative density

Plate 47.

Fig. 1. Average winter prevalence

Fig. 2. Average summer prevalence

Plate 48.

Fig. 3. Average rainy prevalence

Plate 49.

Fig. 1. Average winter mean intensity

Fig. 2. Average summer mean intensity

Plate 50.

Fig. 3. Average rainy mean intensity

Plate 51.

Fig. 1. Average winter relative density

Fig. 2. Average summer relative density

Plate 52.

Fig. 3. Average rainy relative density

Plate 53.

Fig. 1. Average monthwise prevalence in 78-85`F

Fig. 2. Average monthwise mean intensity in 78-85`F

Plate 54.

Fig. 3. Average monthwise relative density in 78-85`F

Plate 55.

Fig. 1. Average monthwise prevalence in 86-93`F

Fig. 2. Average monthwise mean intensity in 86-93`F

Plate 56.

Fig. 3. Average monthwise relative density in 86-93`F

# ABBREVIATIONS

| | | |
|---|---|---|
| AO | - | Accessory organ |
| APR | - | April |
| AUG | - | August |
| BD | - | Bothridia |
| C | - | Cirrus |
| CP | - | Cirrus pouch |
| DEC | - | December |
| E | - | Egg |
| FEB | - | February |
| GA | - | Genital atrium |
| GC | - | Gland cell |
| H | - | Hook |
| IVS | - | Internal seminal vesicle |
| JAN | - | January |
| JUN | - | June |
| MAR | - | March |
| MG | - | Mehlis gland |
| N | - | Neck |
| NOV | - | November |
| O | - | Ovary |
| OCT | - | October |

| | | |
|---|---|---|
| R | - | Rostellum |
| RH | - | Rostellar hook |
| RS | - | Receptaculum seminis |
| S | - | Sucker |
| SC | - | Scolex |
| SEP | - | September |
| T | - | Testes |
| U | - | Uterus |
| V | - | Vagina |
| VD | - | Vas deferens |
| VF | - | Vitelline follicles |
| VLEC | - | Ventral longitudinal excretory canal |

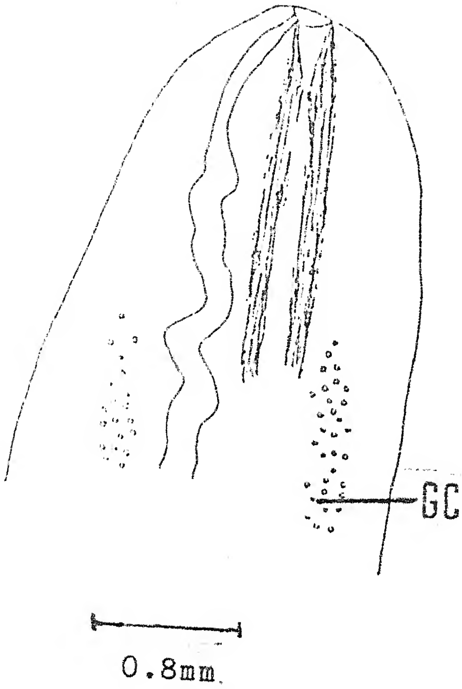



Fig. 1

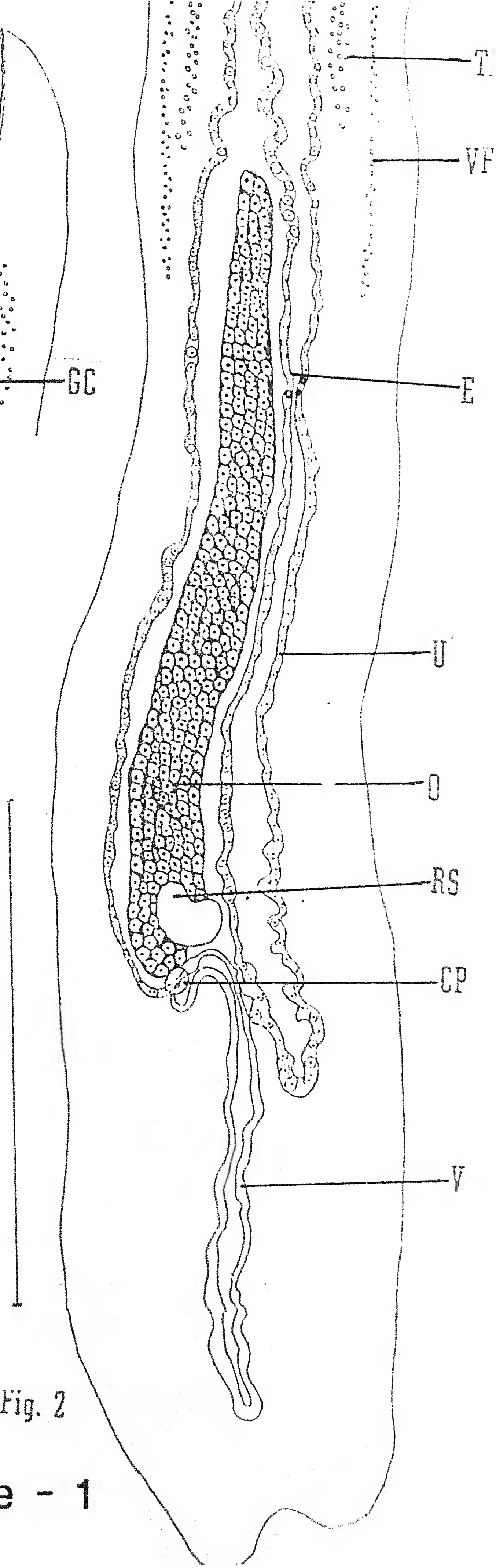



Fig. 2

Plate - 1

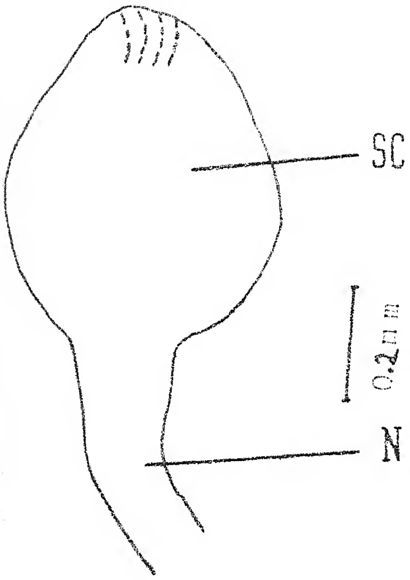



Fig. 1

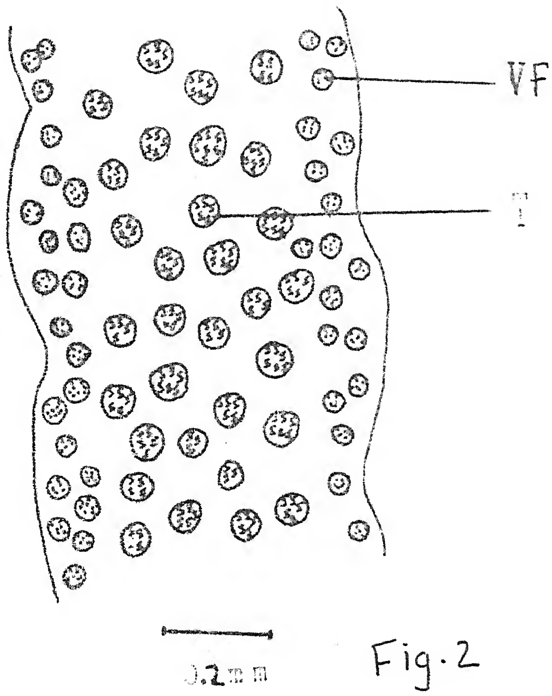
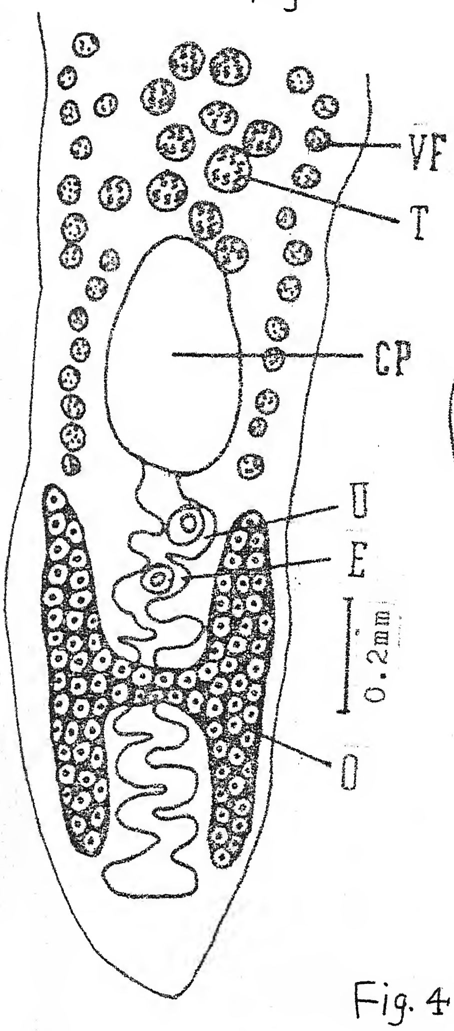



Fig. 2



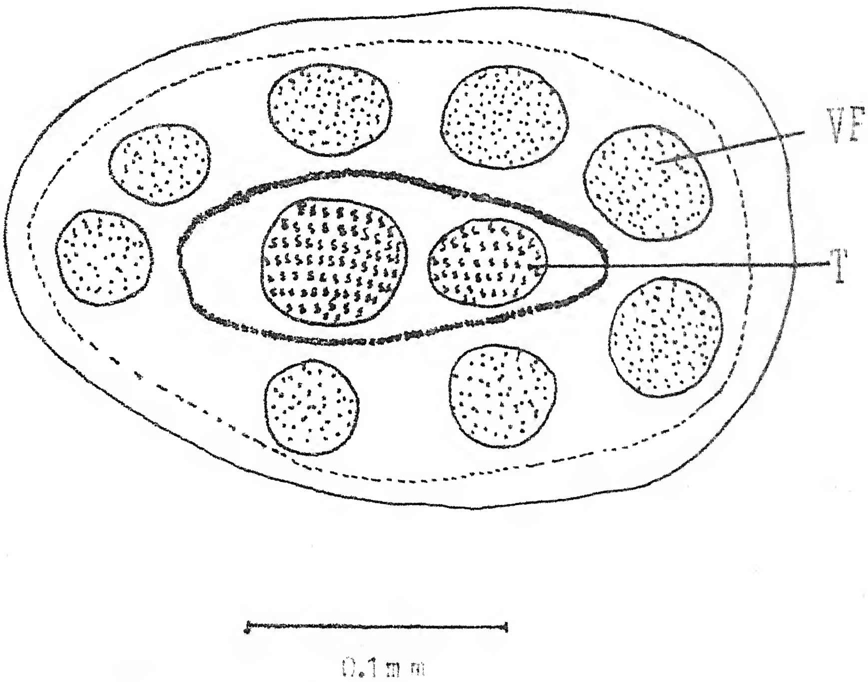




Fig. 3

Fig. 4

Plate - 2

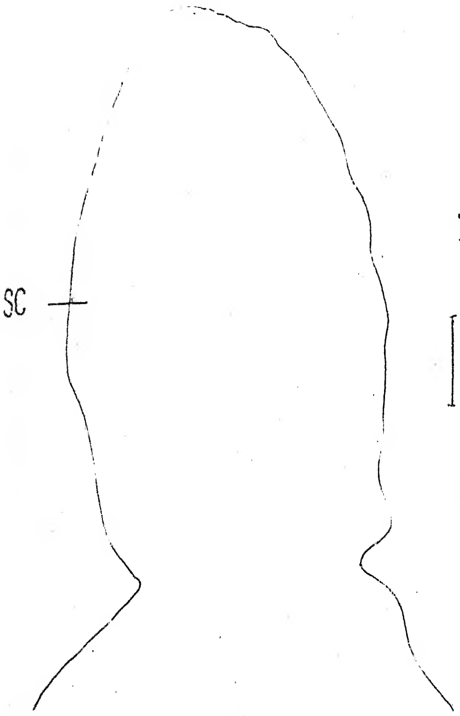



Fig. 1

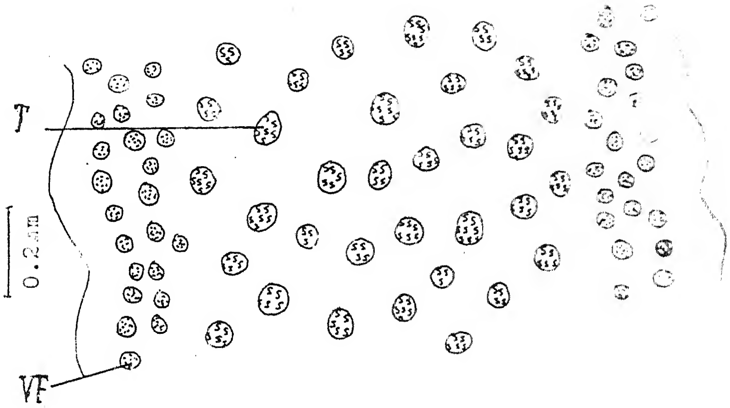



Fig. 2

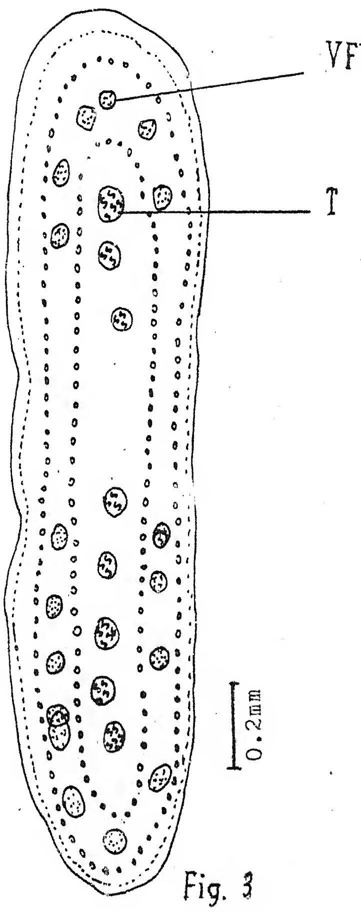



Fig. 3

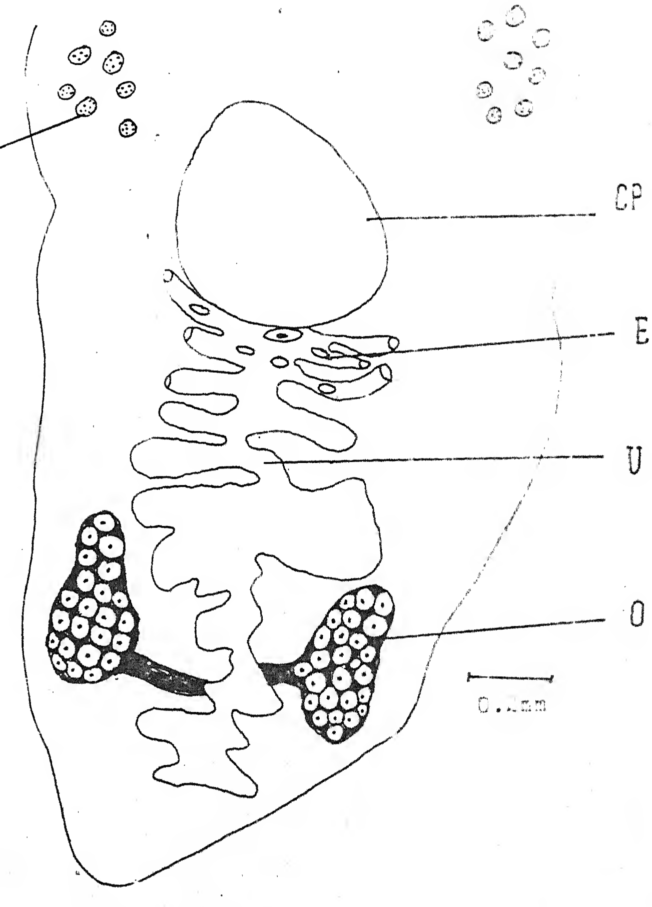



Fig. 4

Plate - 3

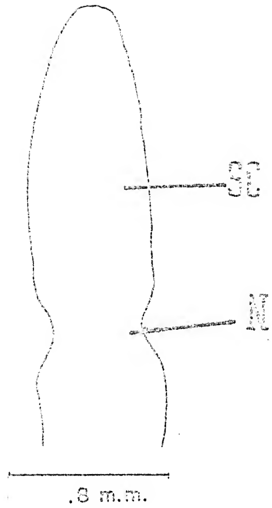



Fig-1

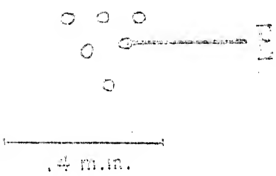



Fig. 4

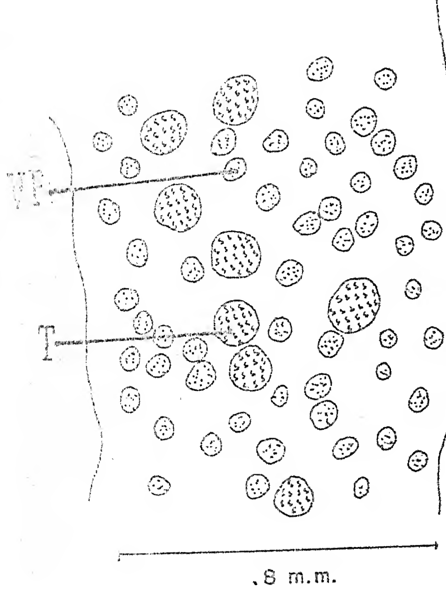



Fig 3

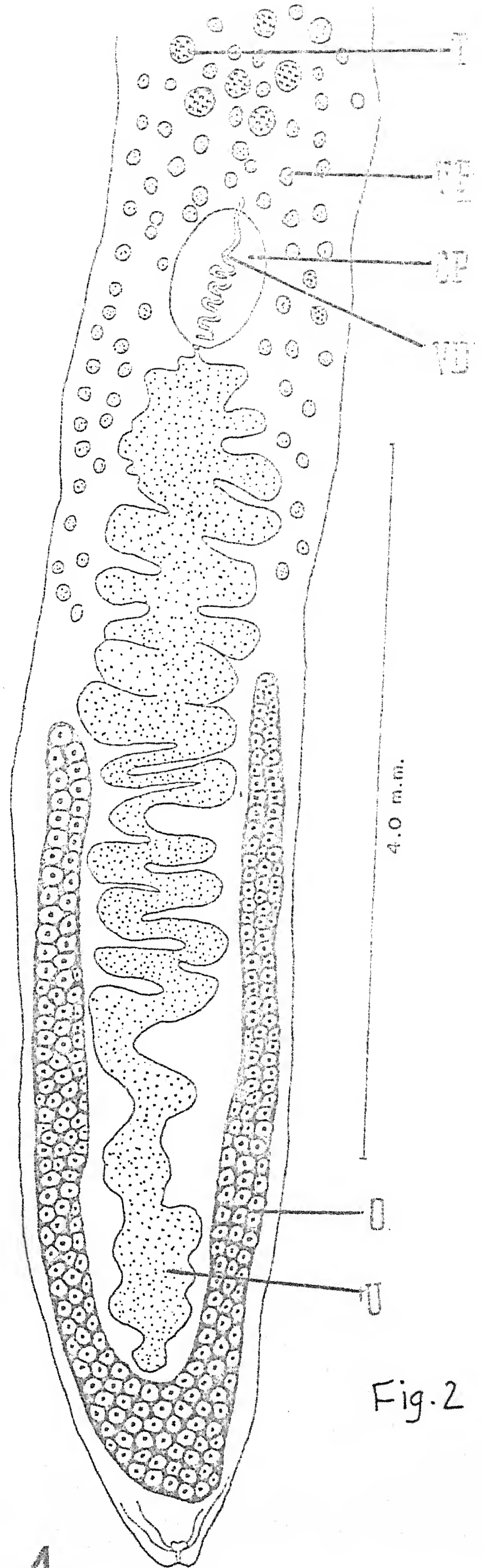



Fig. 2

Plate - 4

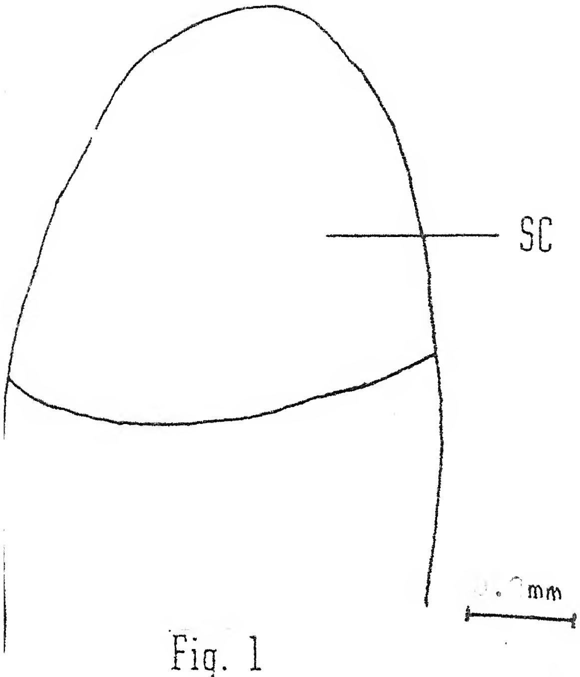



Fig. 1

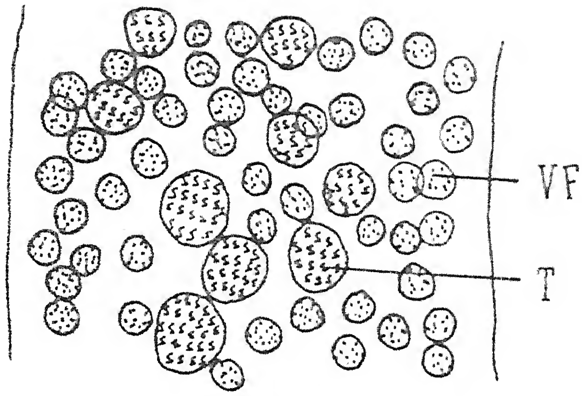



Fig. 2

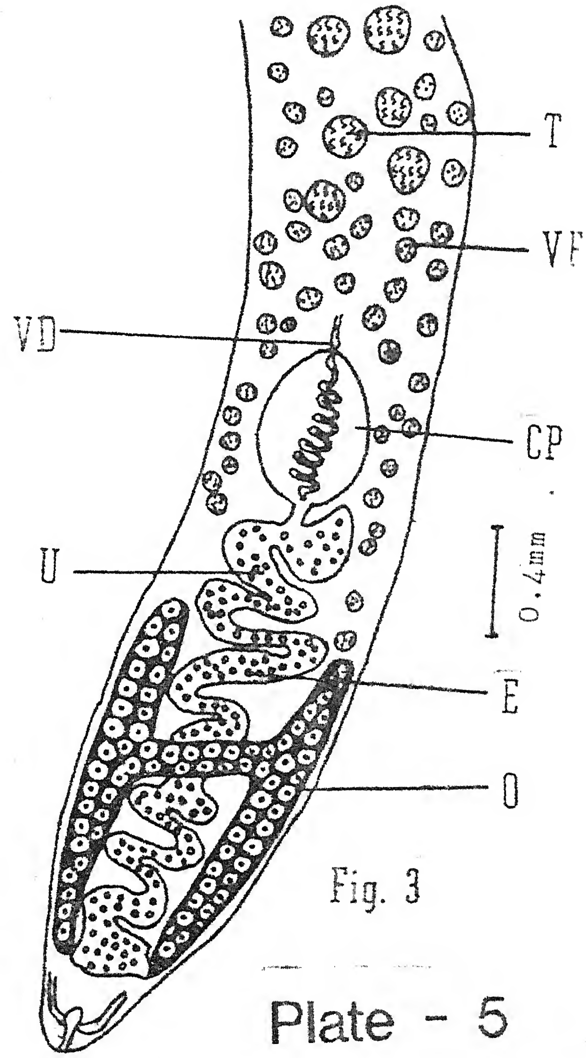



Fig. 3

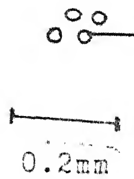



Fig. 4

Plate - 5

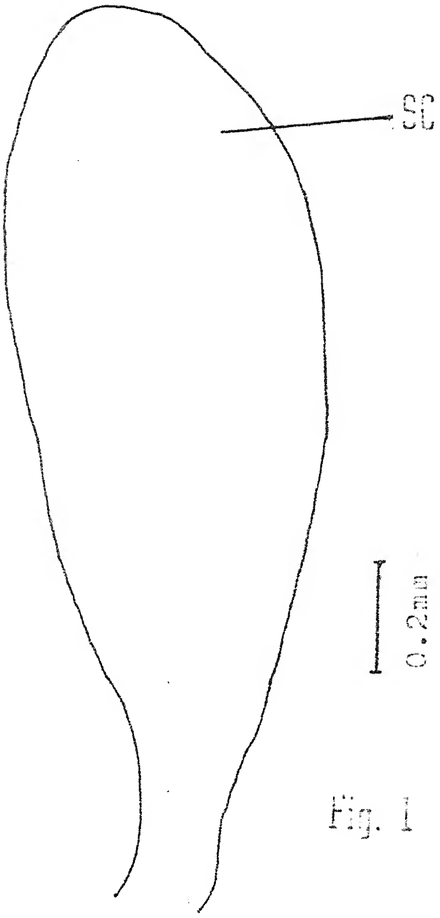



Fig. 1

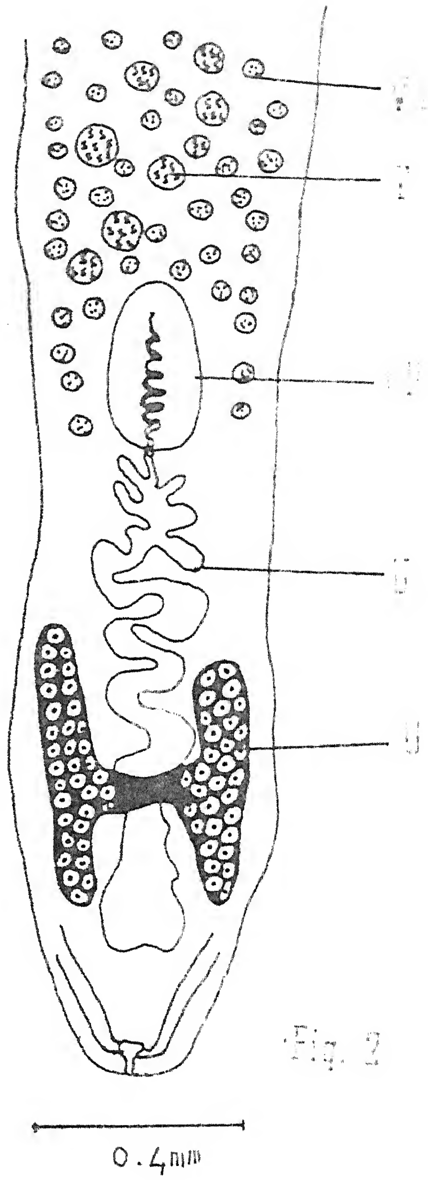



Fig. 2

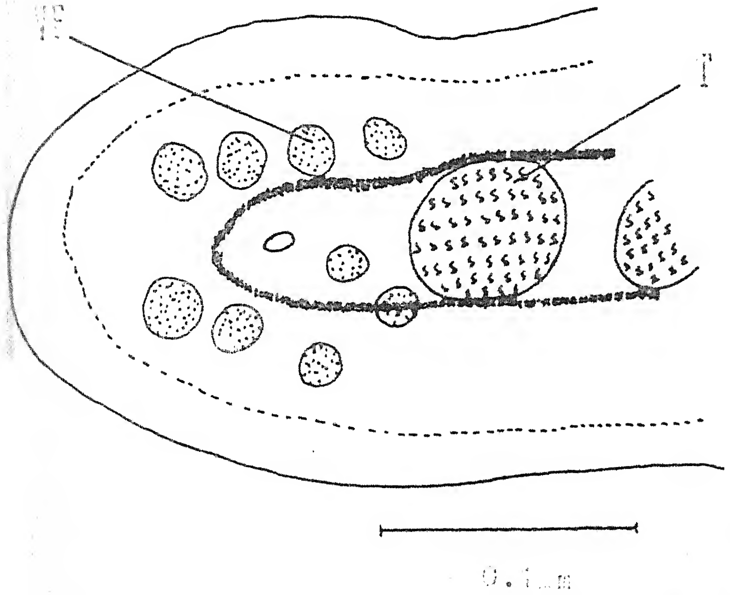



Fig. 3

Plate - 6

Fig. 1

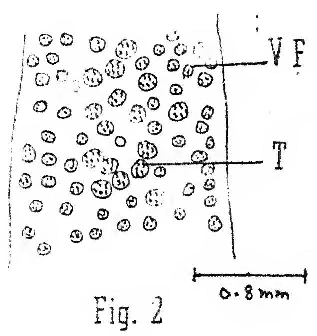



Fig. 2

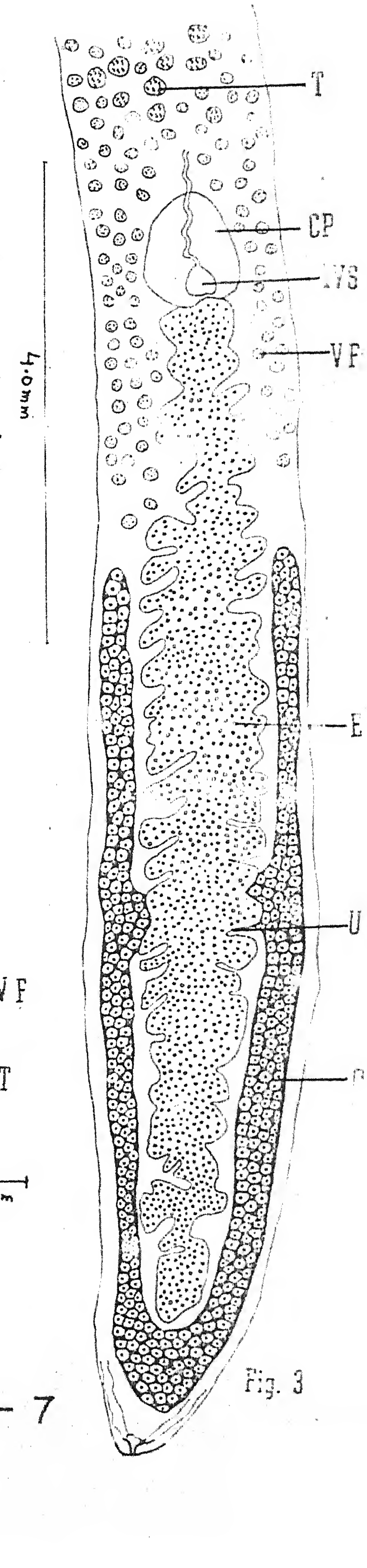



Fig. 3

Plate - 7

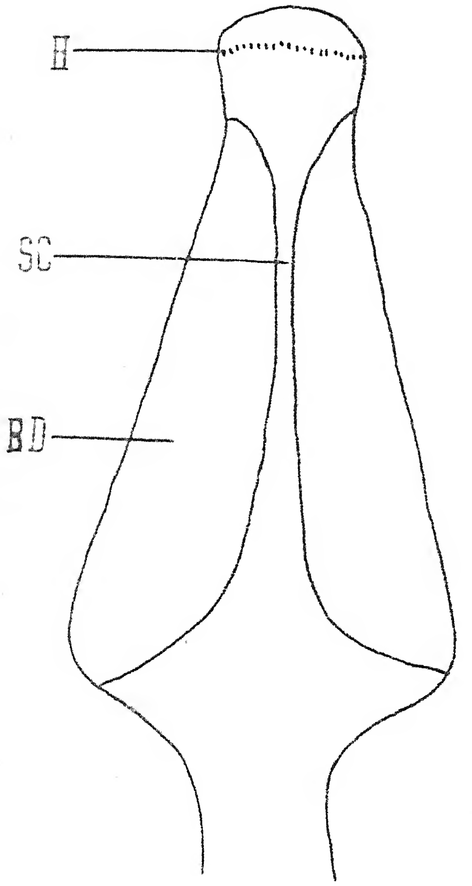



Fig. 1

0.4mm

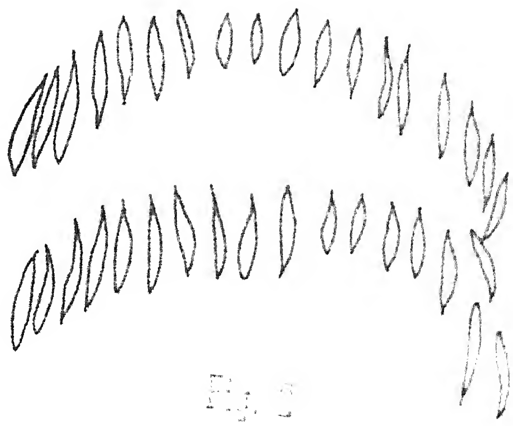


Fig. 2

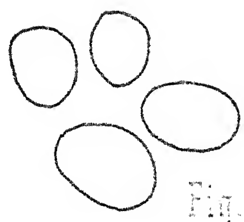


Fig. 5

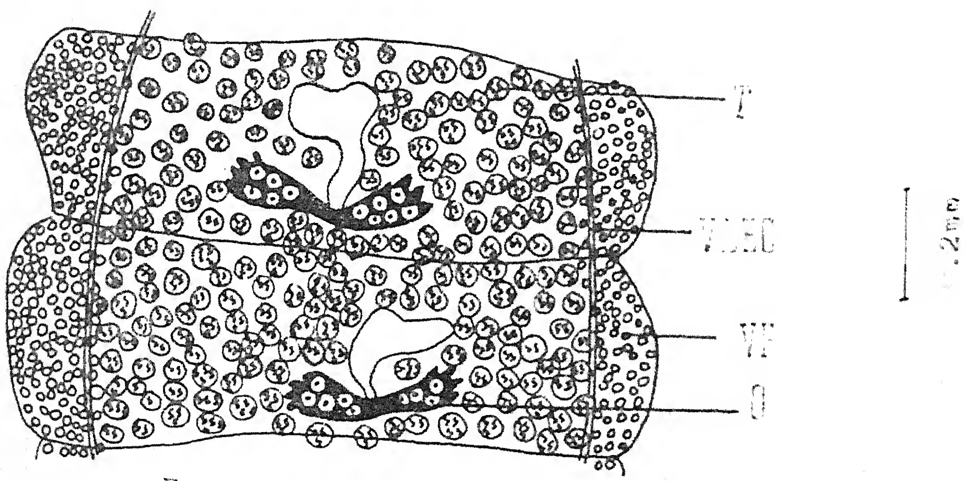
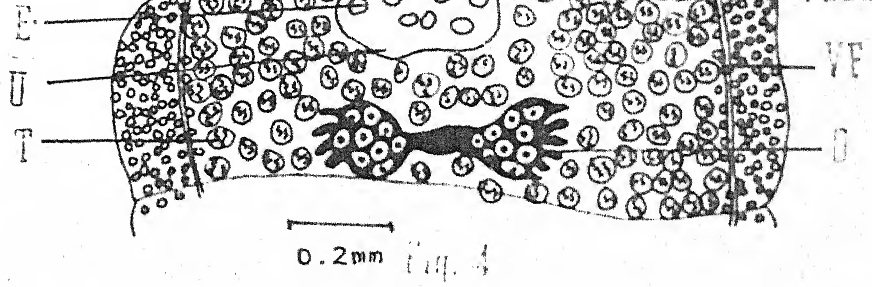



Fig. 3




0.2mm Fig. 4

Plate - 8

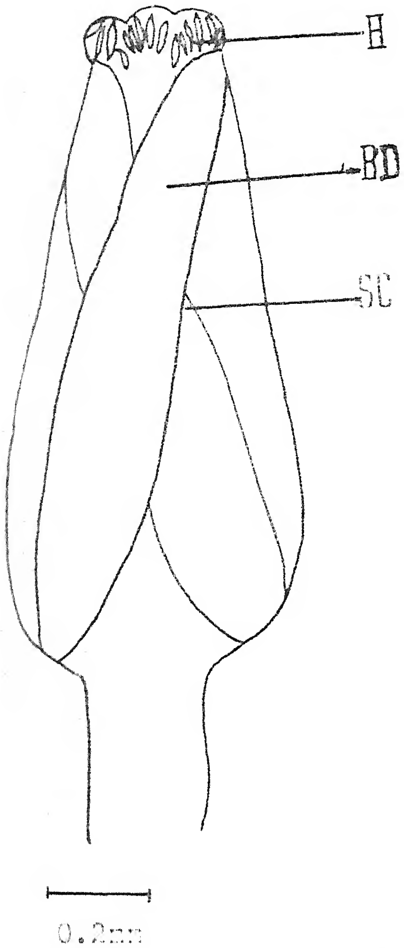



Fig. 1

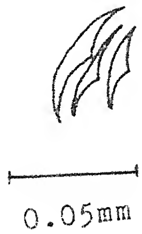



Fig. 2

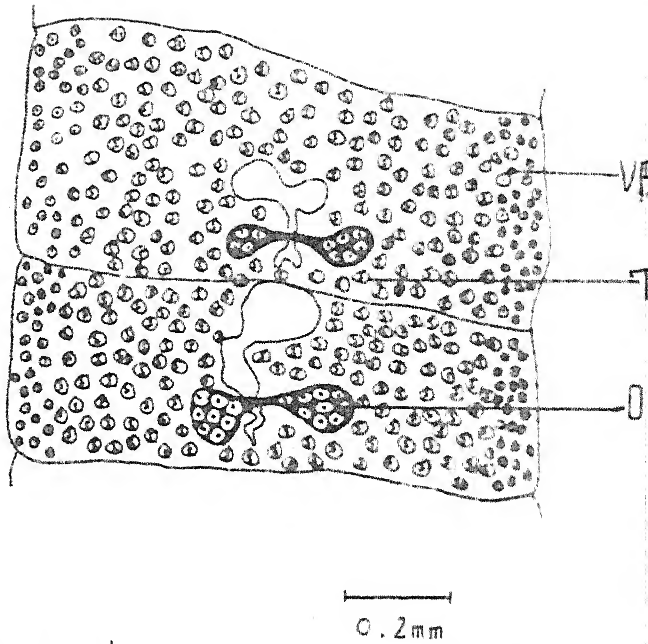



Fig. 3

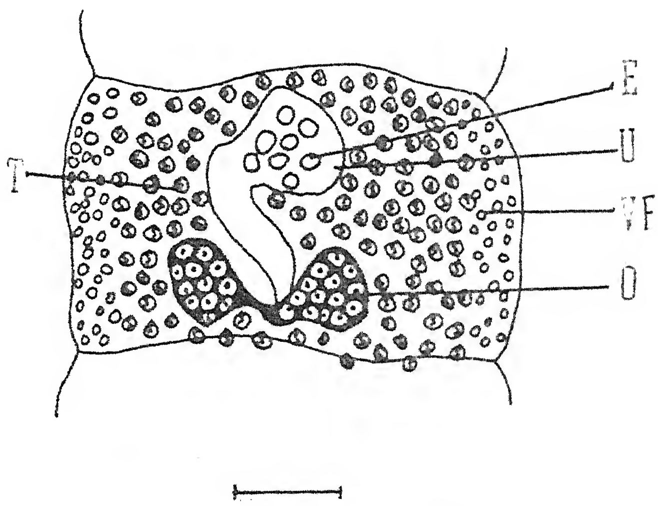



Fig. 4

Plate - 9

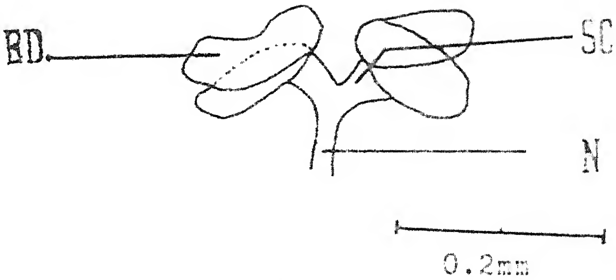



Fig. 1

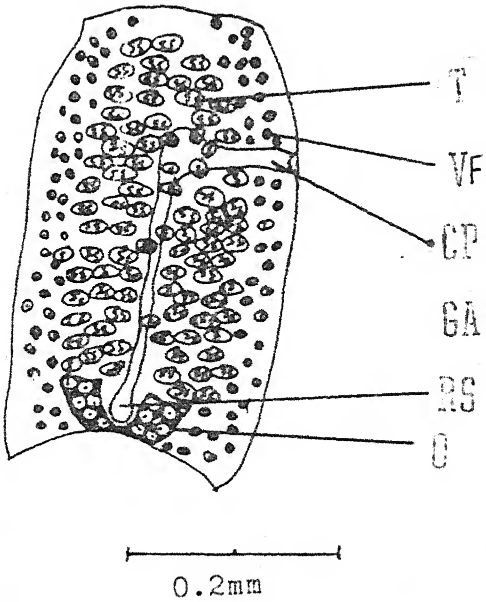



Fig. 2

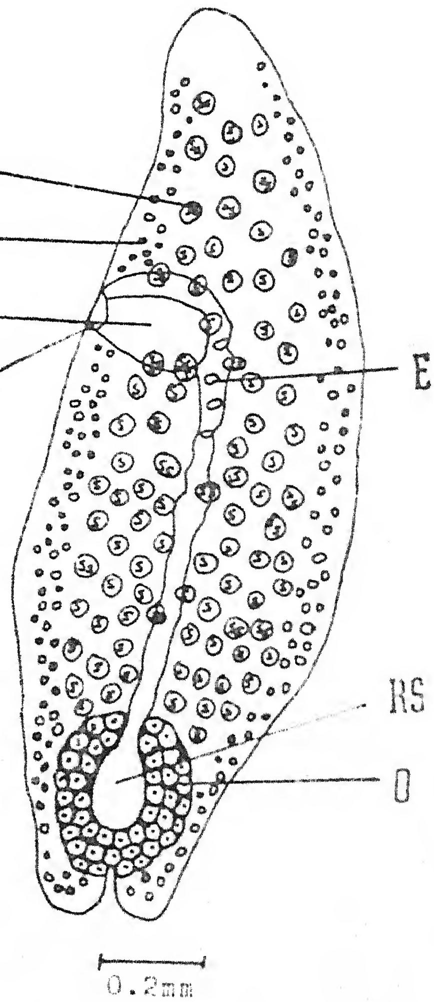



Fig. 3

Plate - 10

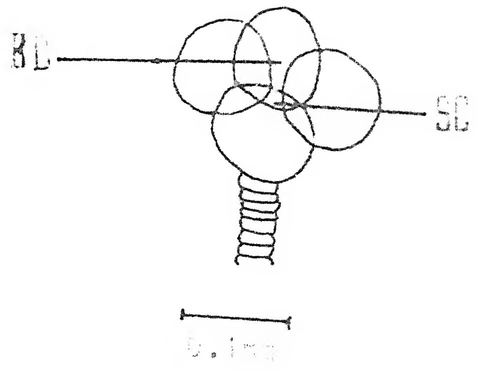



Fig. 1

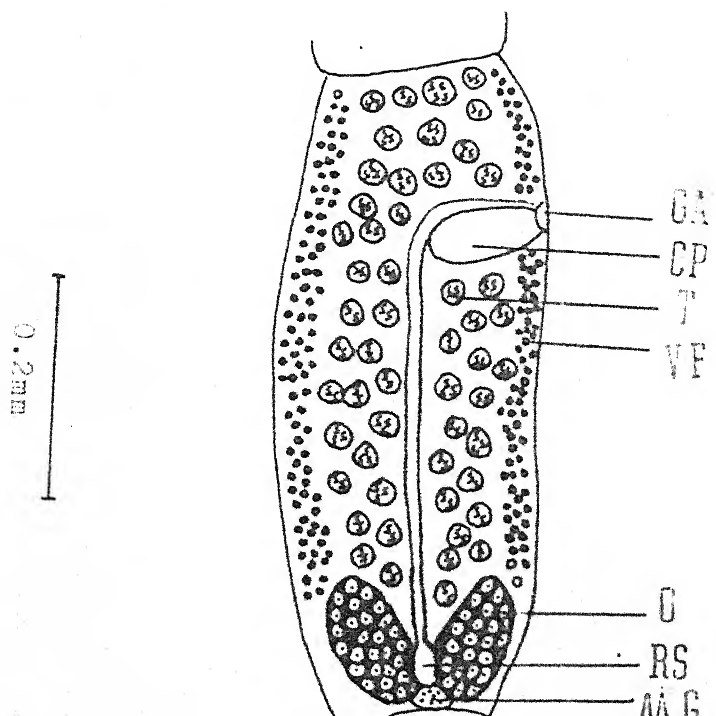



Fig. 2

Plate - 11

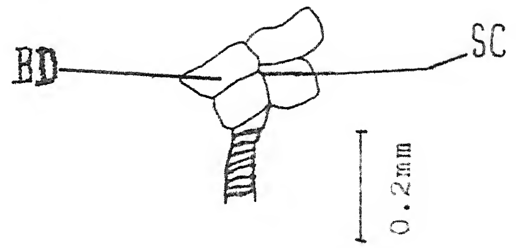
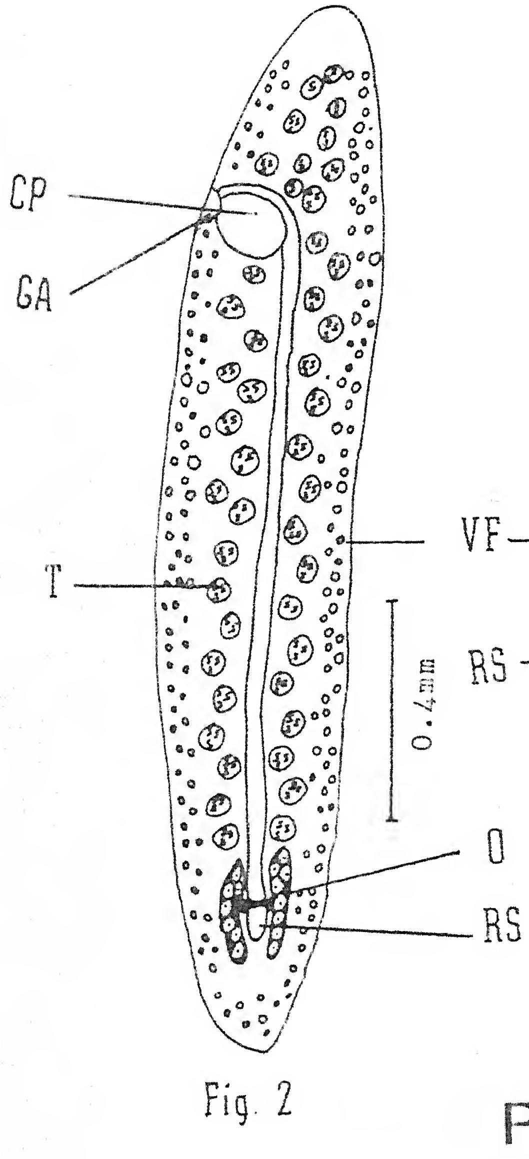



Fig. 1



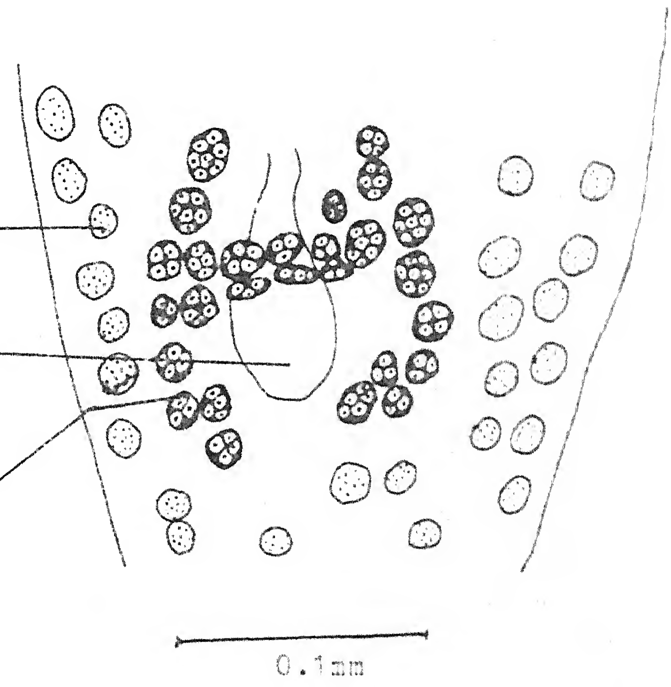




Fig. 3

Fig. 2

Plate - 12

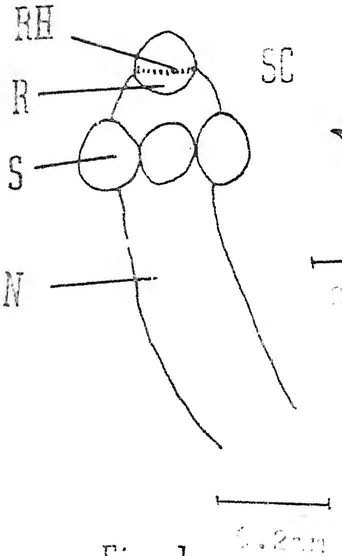



Fig. 1

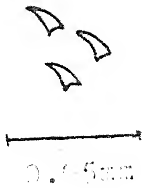


Fig. 5

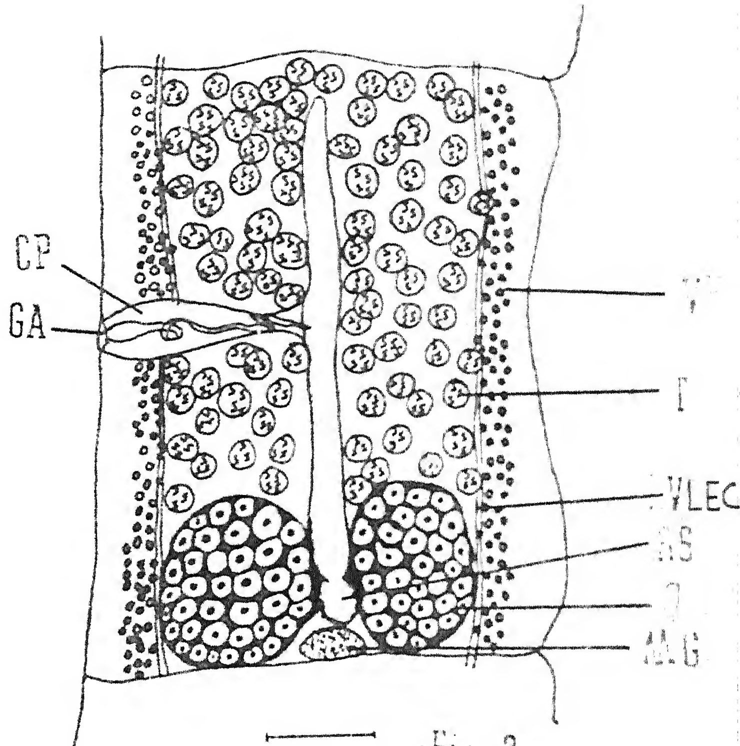



Fig. 2

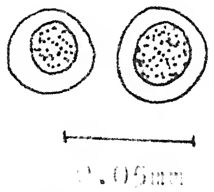



Fig. 6

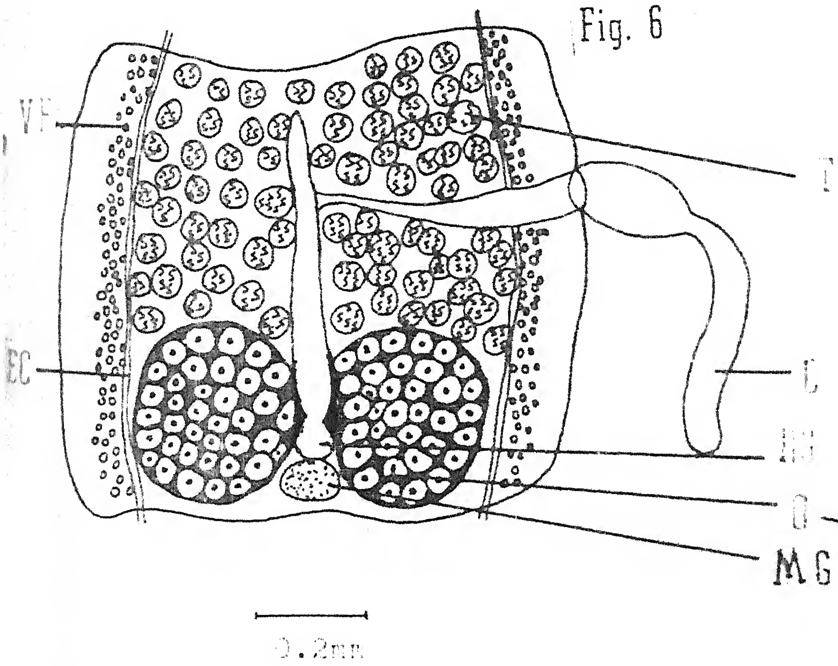



Fig. 3

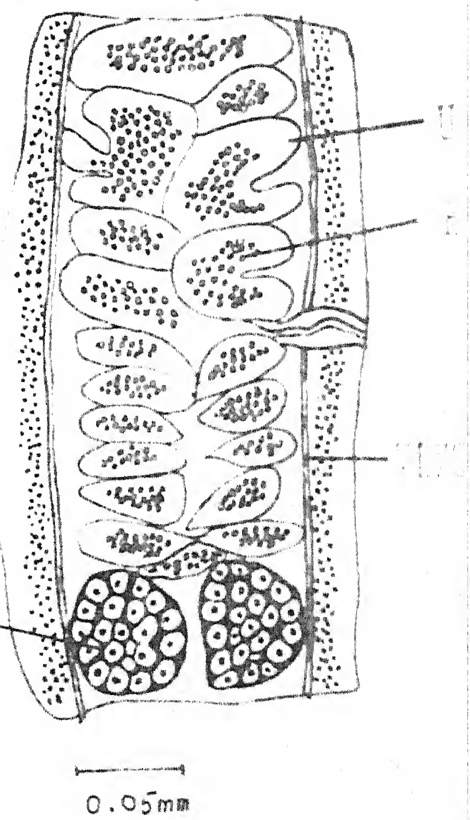



Fig. 4

Plate - 13

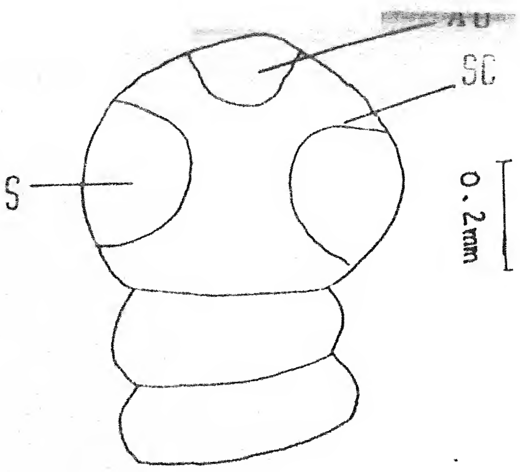



Fig. 1

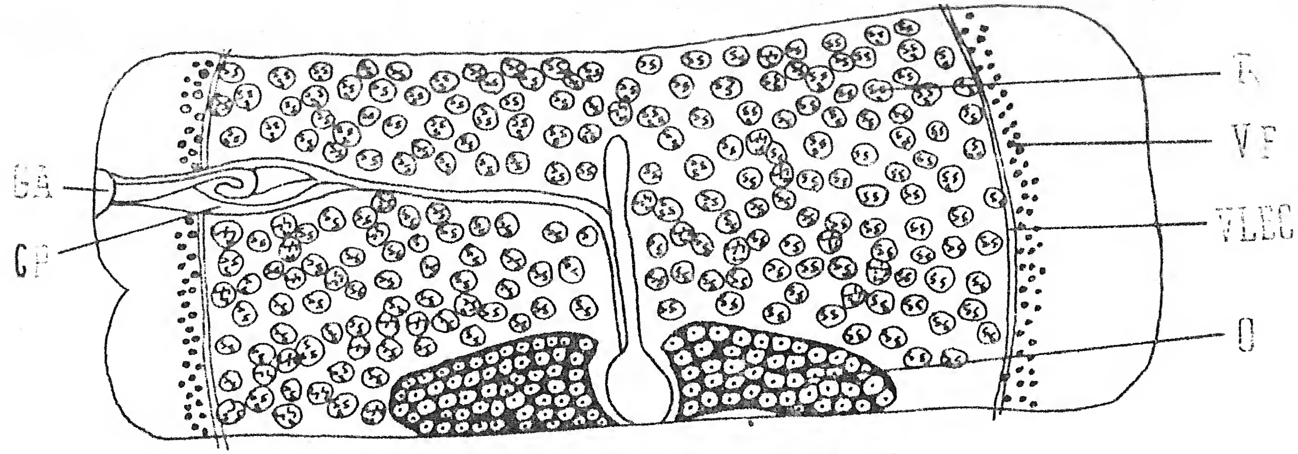



Fig. 2

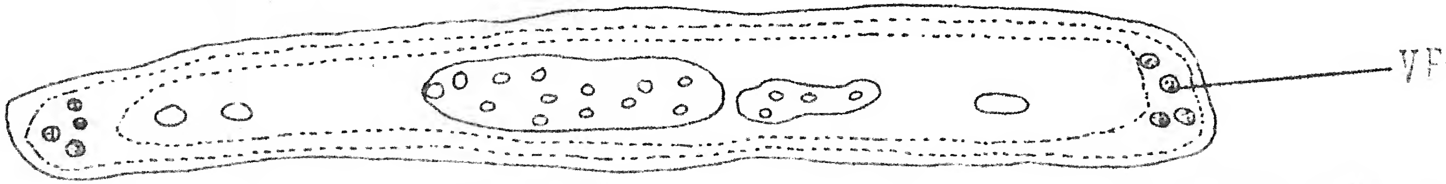
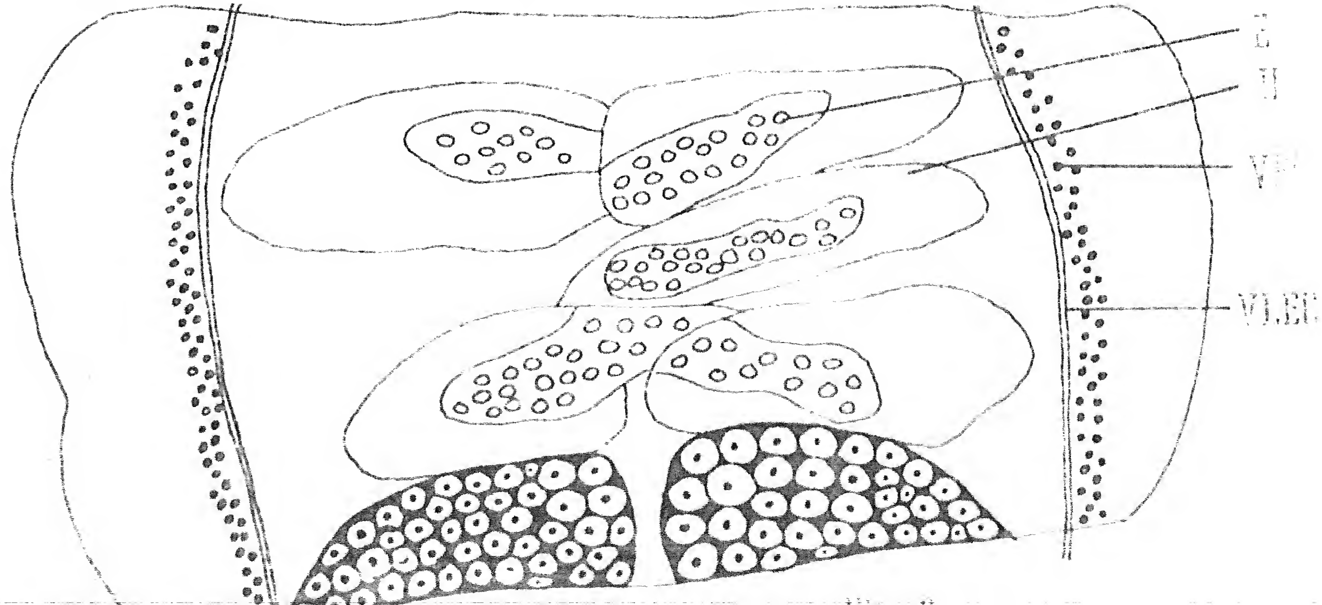



Fig. 4



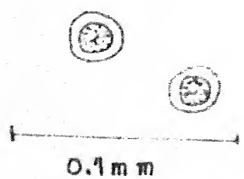




Fig. 5

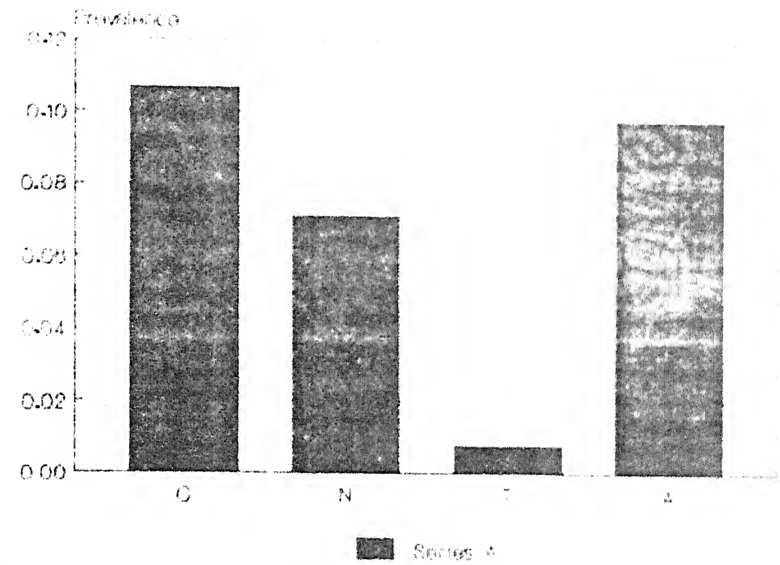



Fig. No. 1

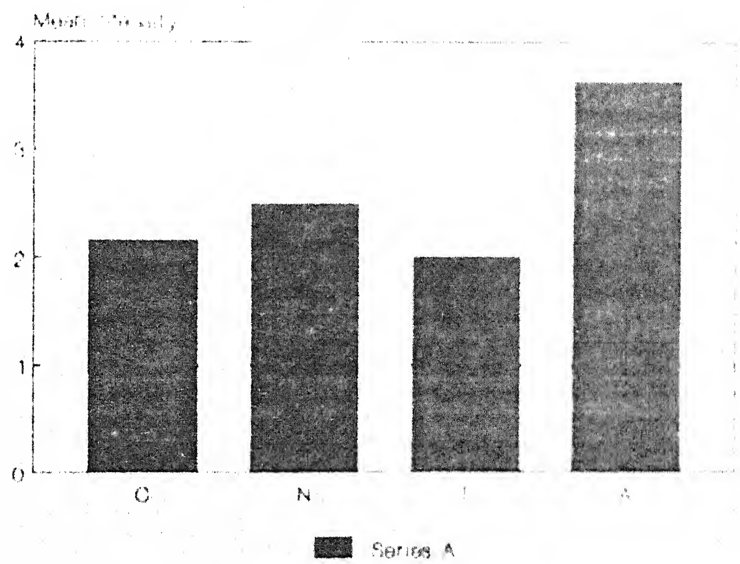



Fig. No. 2

Plate - 15

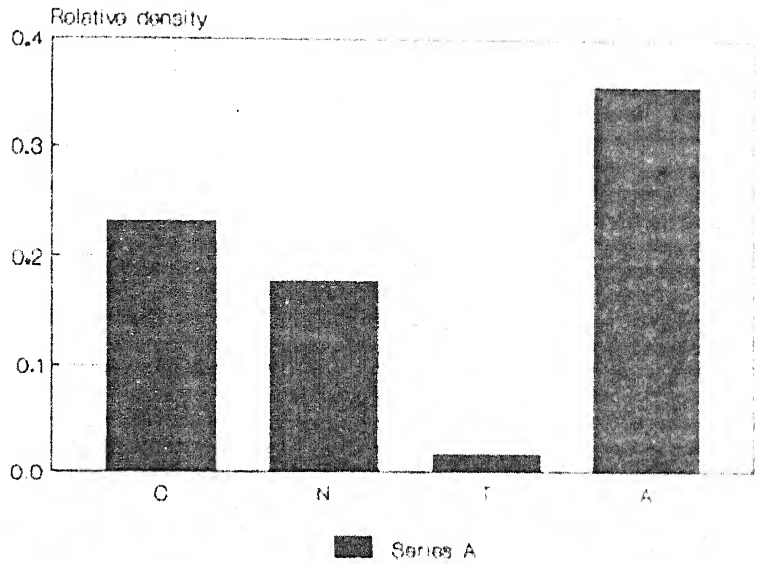



Fig. No. 3

Plate - 16

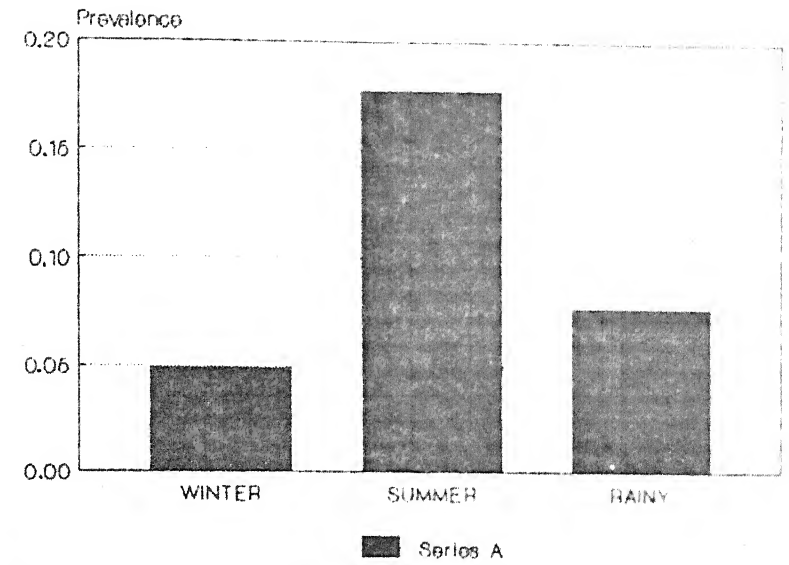


Fig. No. 1

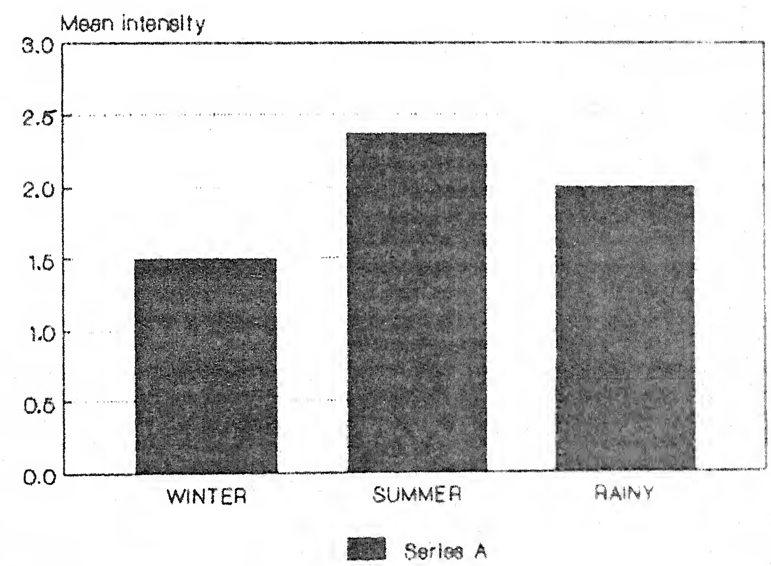


Fig. No. 2

Plate - 17

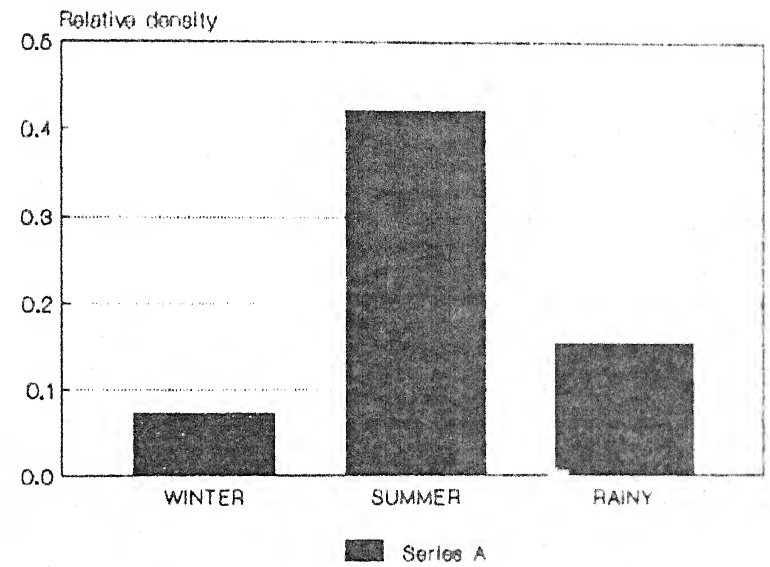


Fig. No. 8

Plate - 18

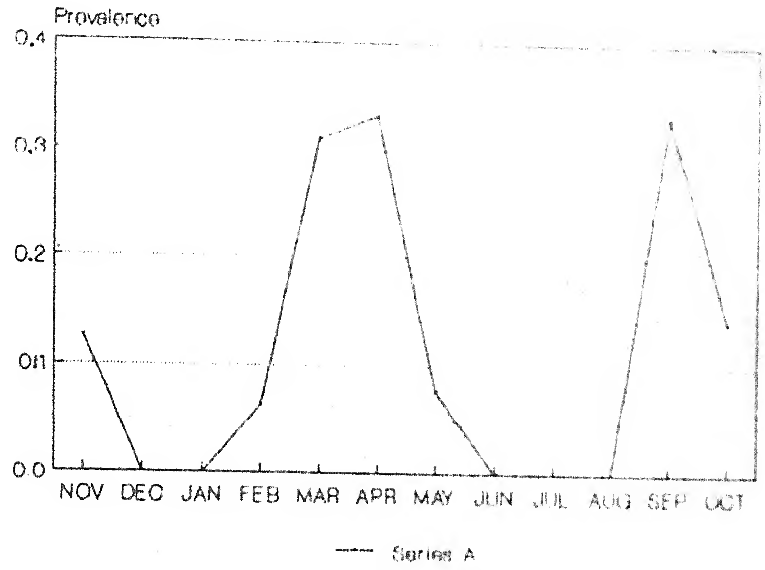



Fig. No. 1

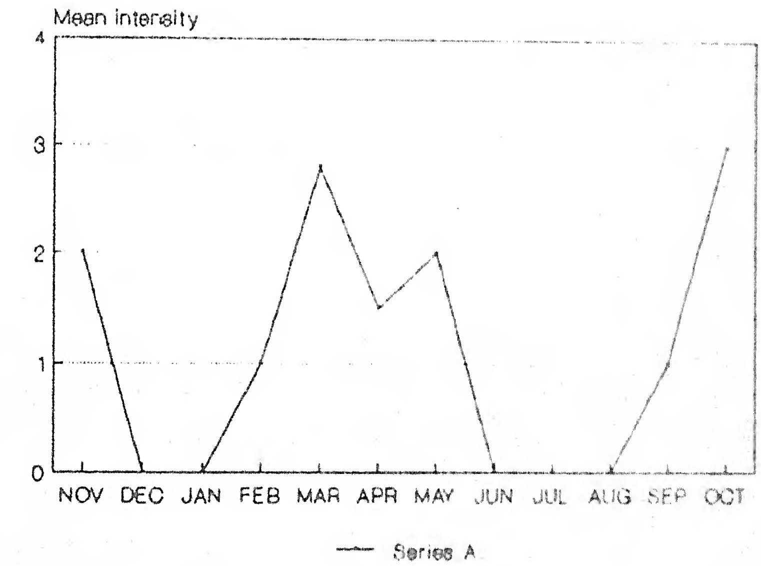



Fig. No. 2

Plate - 19

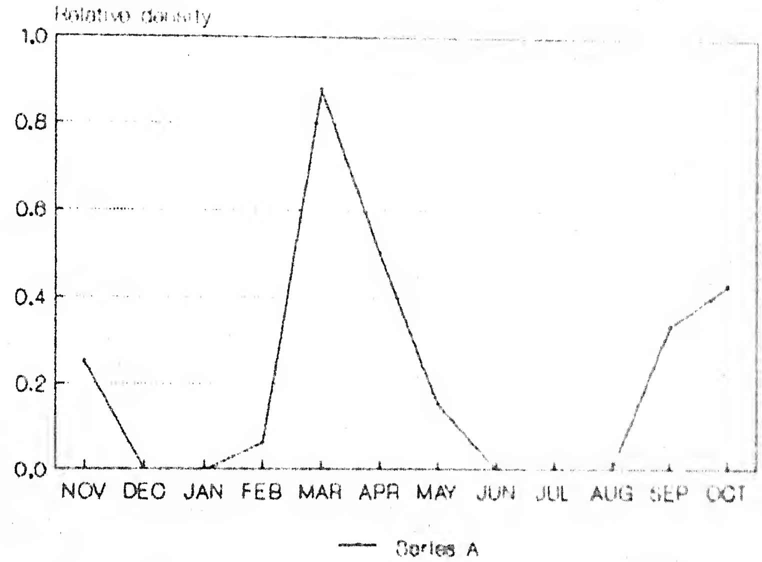



Fig. No. 8

Plate - 20

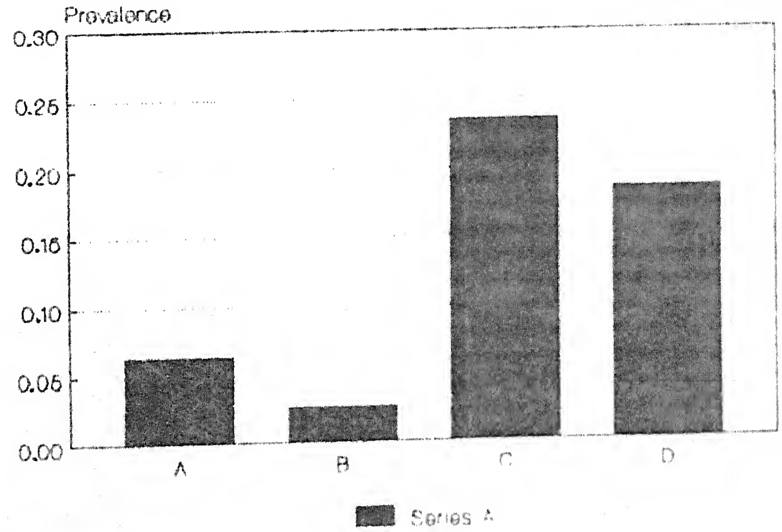



Fig No.1 A 51-100g, B 101-150g
C 151-200g, D 201-250g

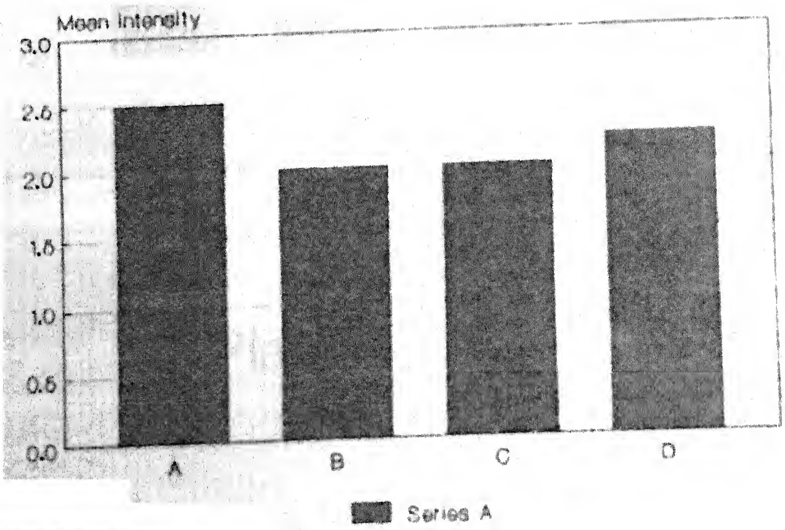



Fig No.2 A 51-100g, B 101-150g
C 151-200g, D 201-250g

Plate - 21

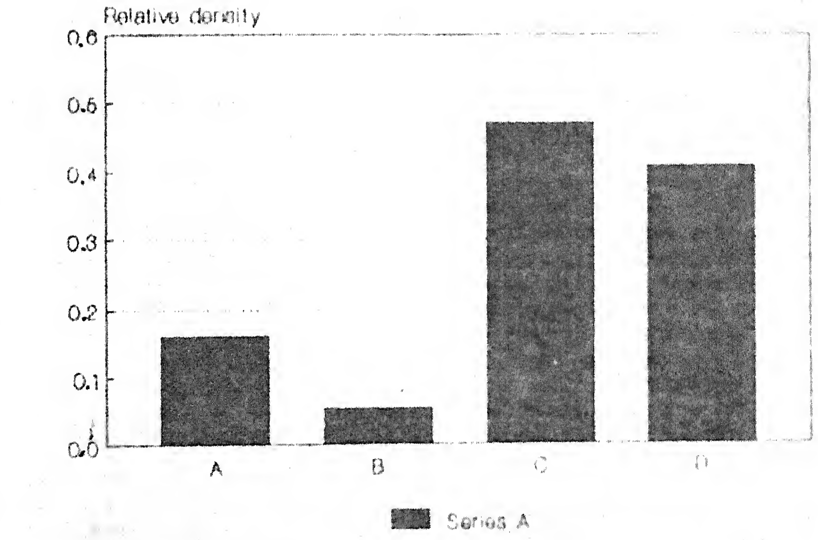



Fig No.3 A 51-100g. B 101-150g
C 151-200g. D 201-250g.

Plate - 22

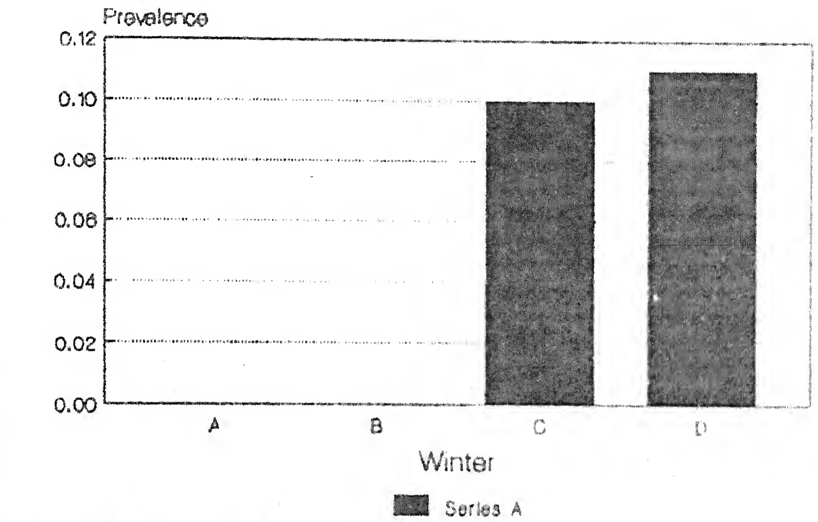



Fig. No. 1 Ranges are given below
A 51-100 B 101-150 C 151-200
D 201-250

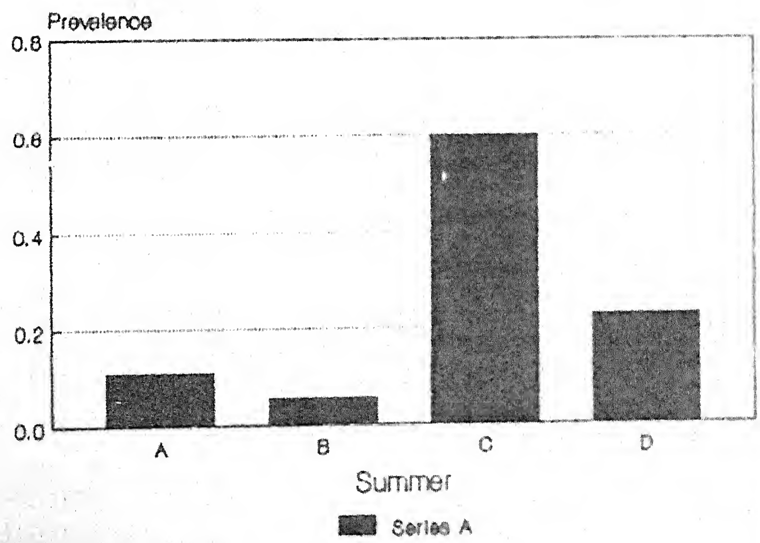



Fig No.2 A 51-100g. B 101-150g.
C 151-200g. D 201-250g.

Plate - 23

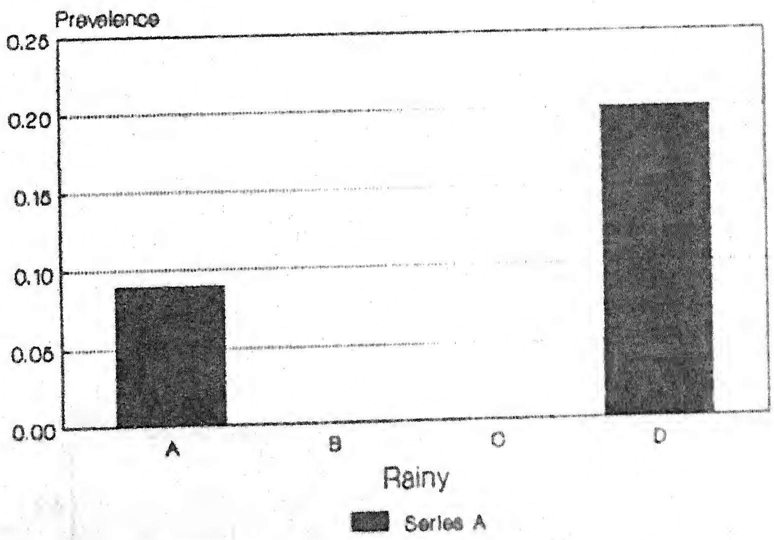



Fig No.3 A 51-100g. B 101-150g.
C 151-200g. D 201-250g.

Plate - 24

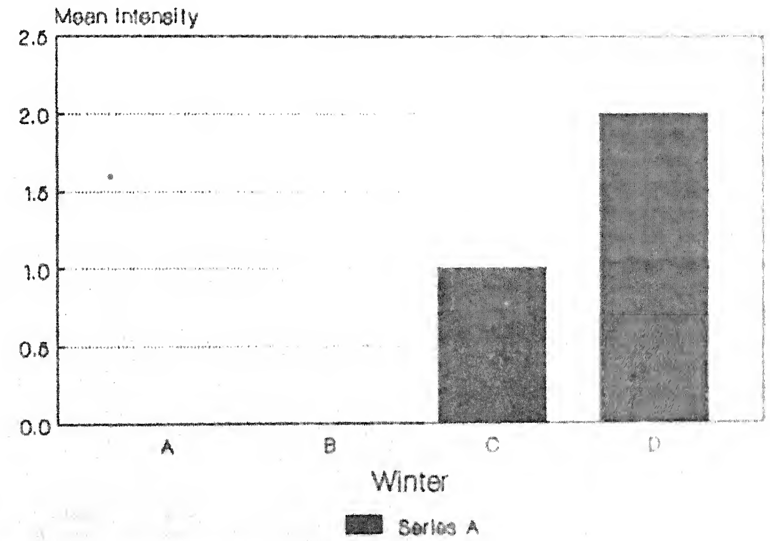



Fig No.1 A 51-100g. B 101-150g.
C 151-200g. D 201-250g.

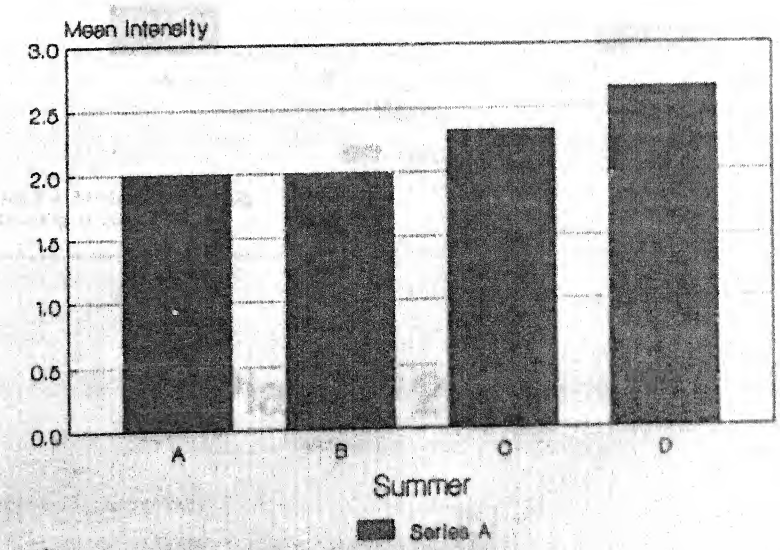



Fig. No.2 A 51-100g. B 101-150g.
C 151-200g. D 201-250g.

Plate - 25

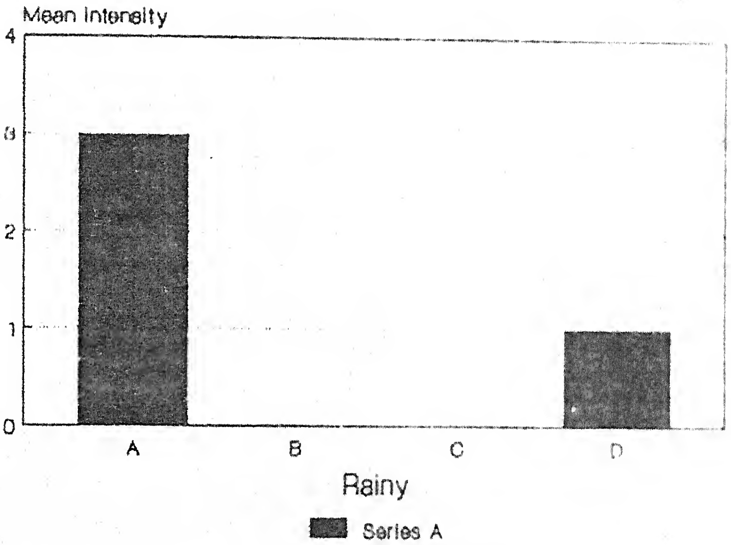



Fig. No.3 A 51-100g. B 101-150g.
C 151-200g. D 201-250g.

Plate - 26

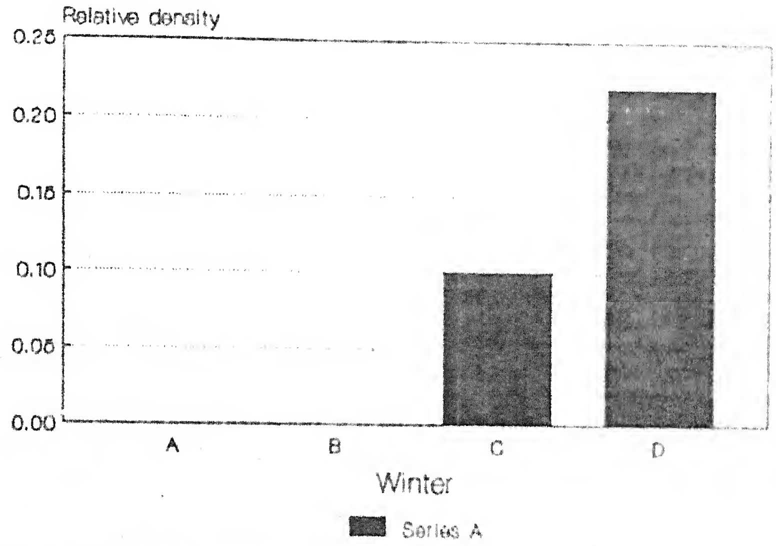



Fig. No.1 A 51-100g. B 101-150g.
C 151-200g. D 201-250g.

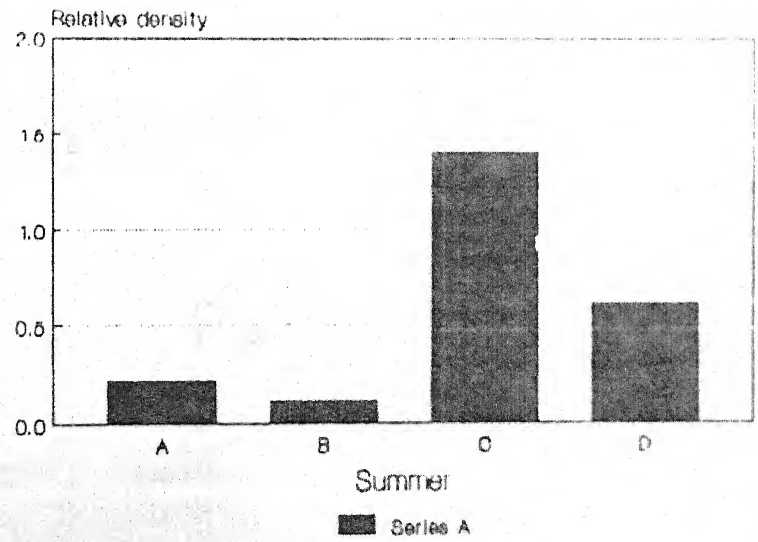



Fig. No.2 A 51-100g. B 101-150g.
C 151-200g. D 201-250g.

# Plate - 27

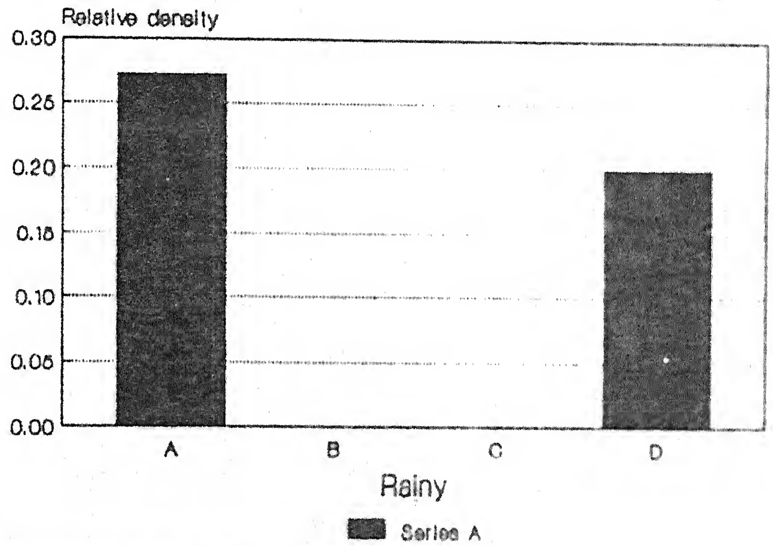



Fig. No.3 A 51-100g. B 101-150g.
C 151-200g. D 201- 250g.

Plate - 28

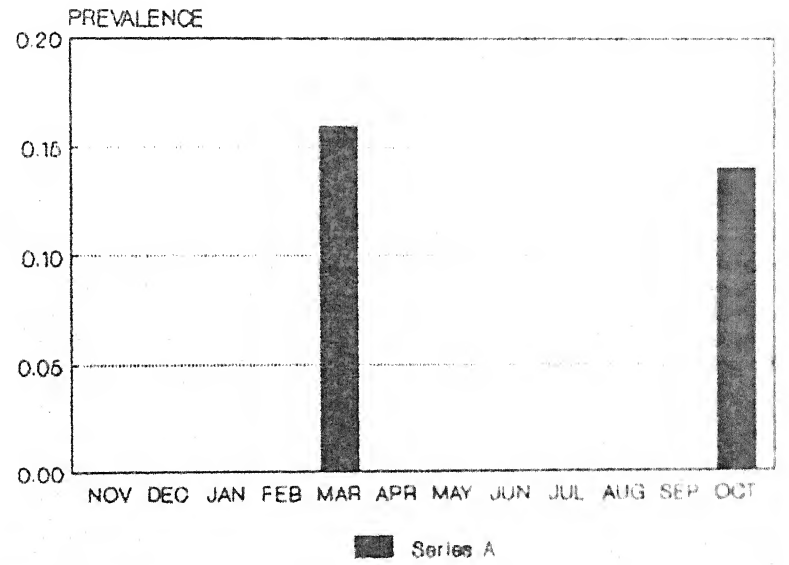



Fig.No. 1 81 - 100 g.

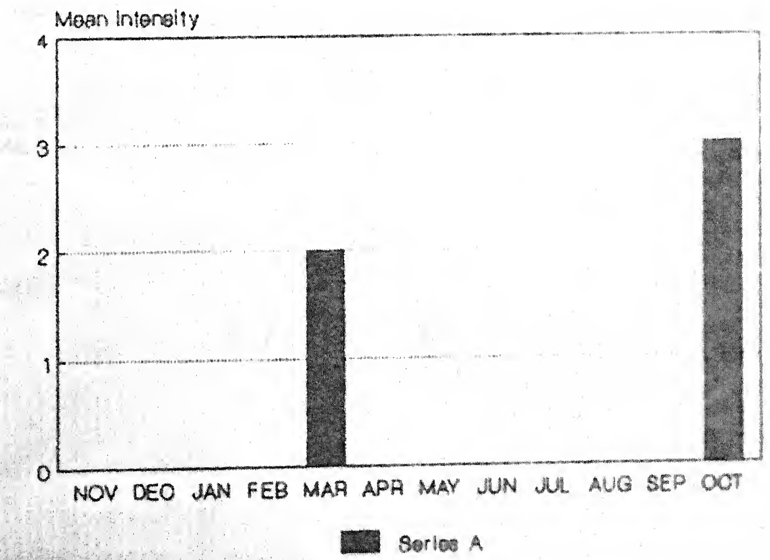



Fig.No.2 81 - 100g.

Plate - 29

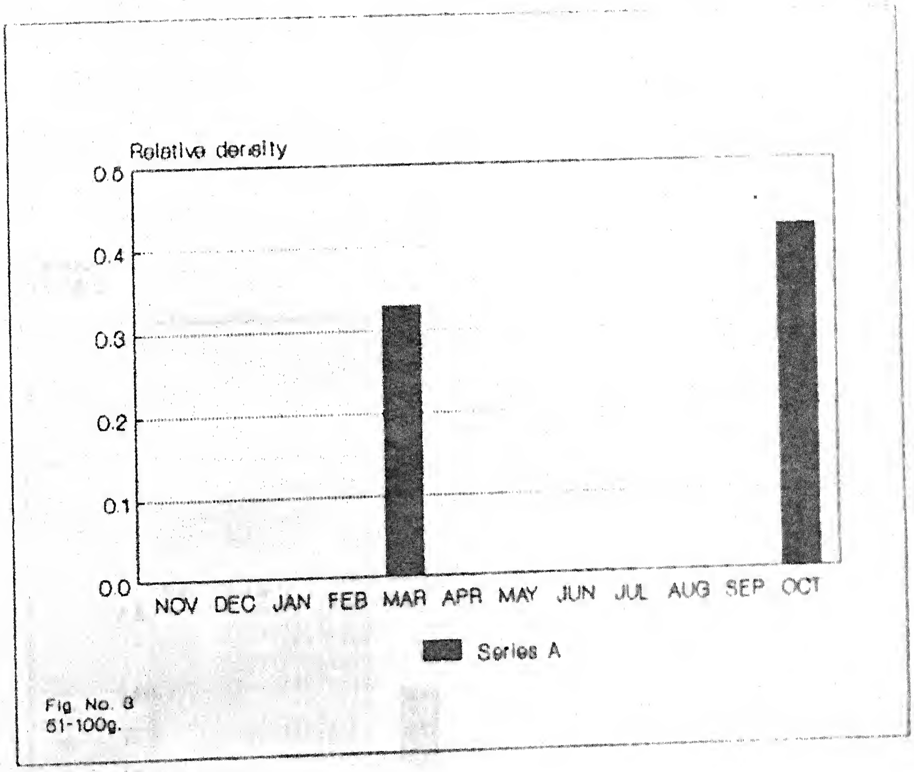

Relative density
0.5
0.4
0.3
0.2
0.1
0.0
NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT
Series A
Fig. No. 8
51-100g.

Plate - 30

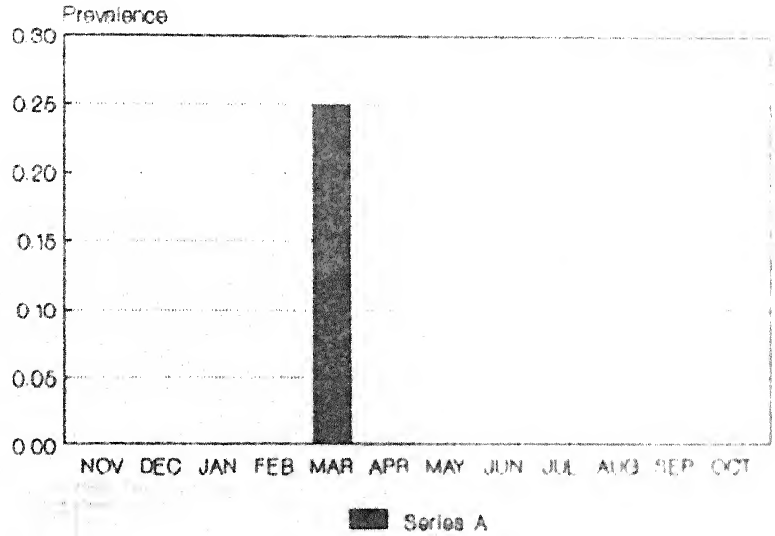



Fig. No. 1
101-150g.

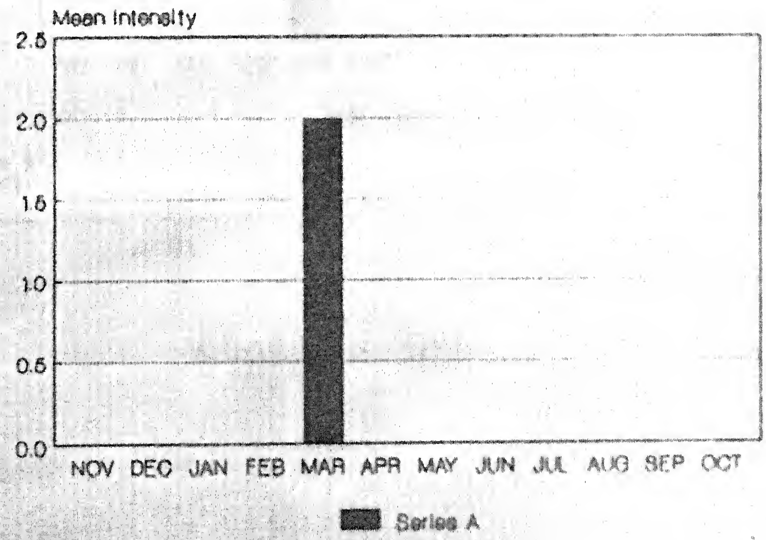



Fig. No. 2
101-150g.

Plate - 31

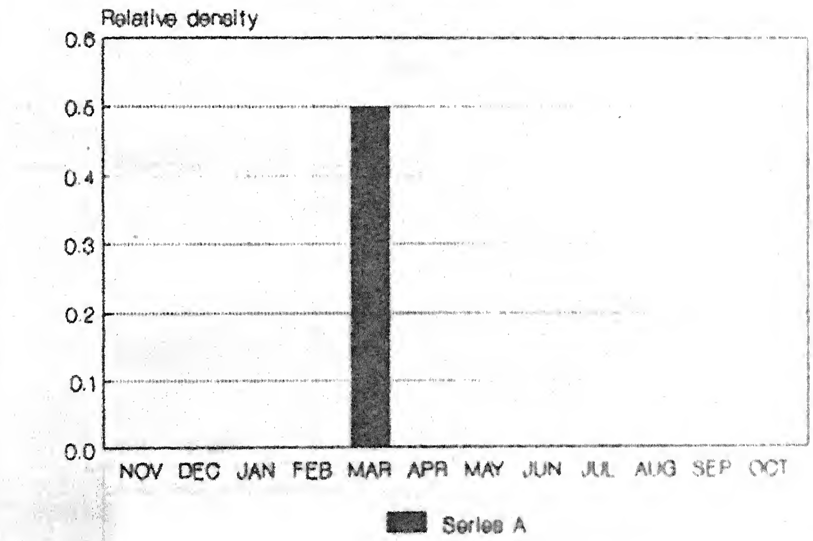



Fig. No. 8
101-150g.

Plate - 32

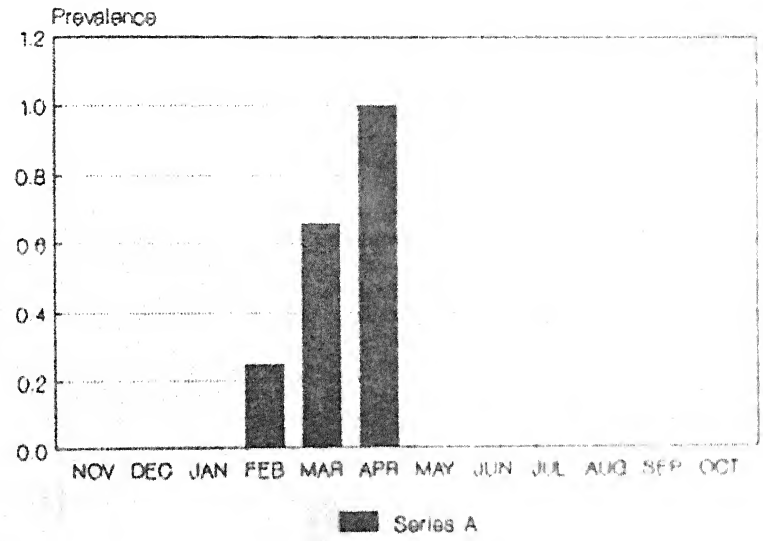



Fig. No. 1
151-200g.

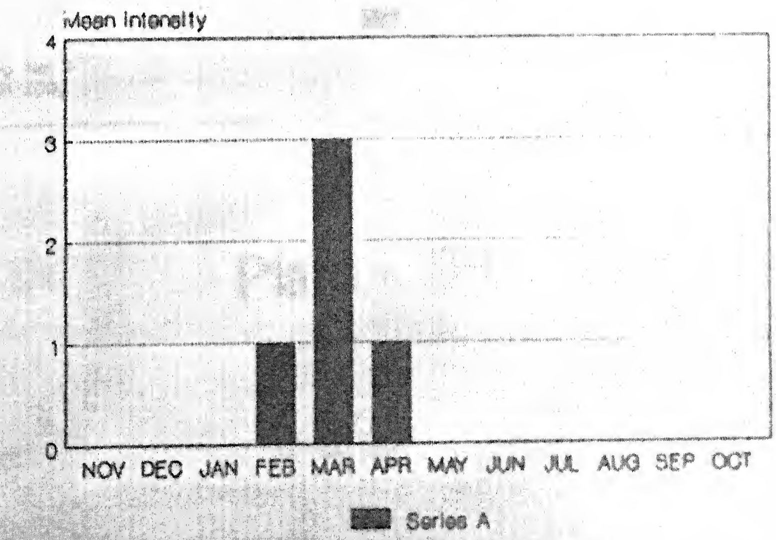



Fig. No. 2
151-200g.

Plate - 33

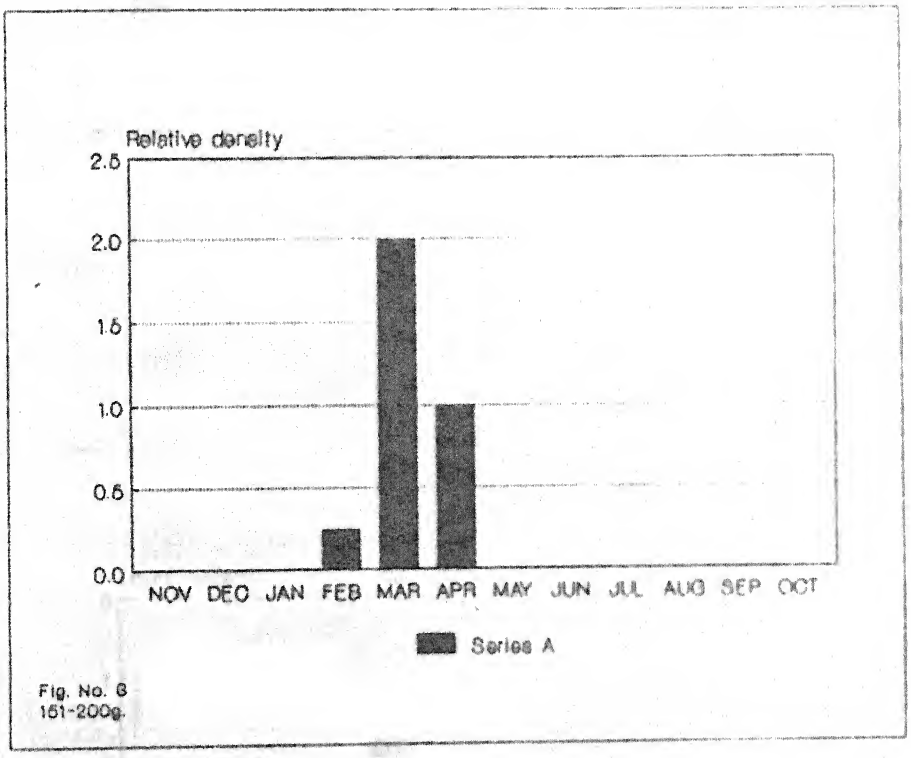

Relative density
2.5
2.0
1.5
1.0
0.5
0.0
NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT
Series A
Fig. No. 6
151-200g.

Plate - 34

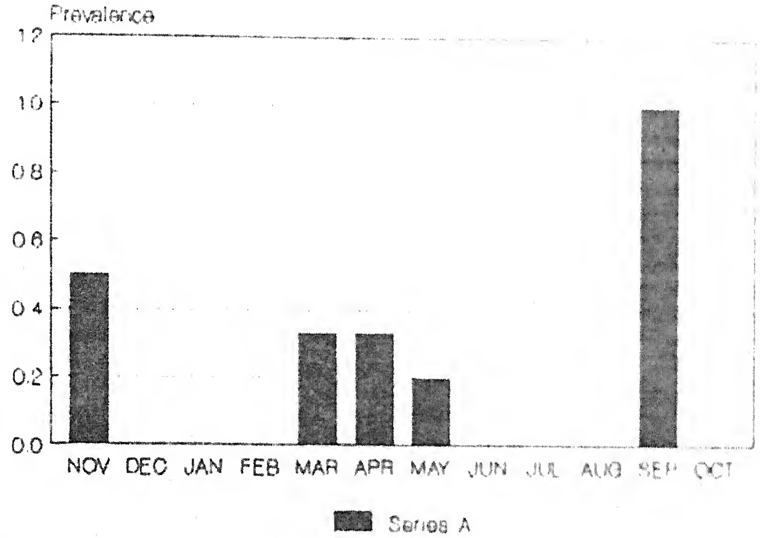



Fig. No. 1
201-250g.

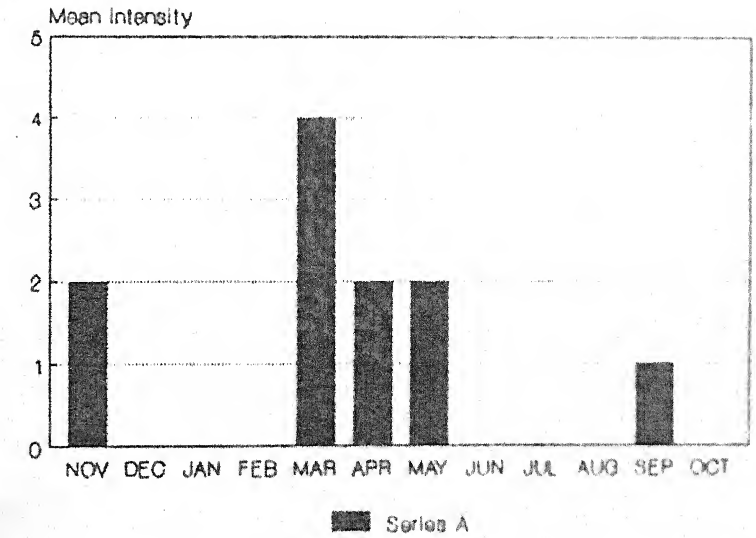



Fig. No. 2
201-250g.

Plate - 35

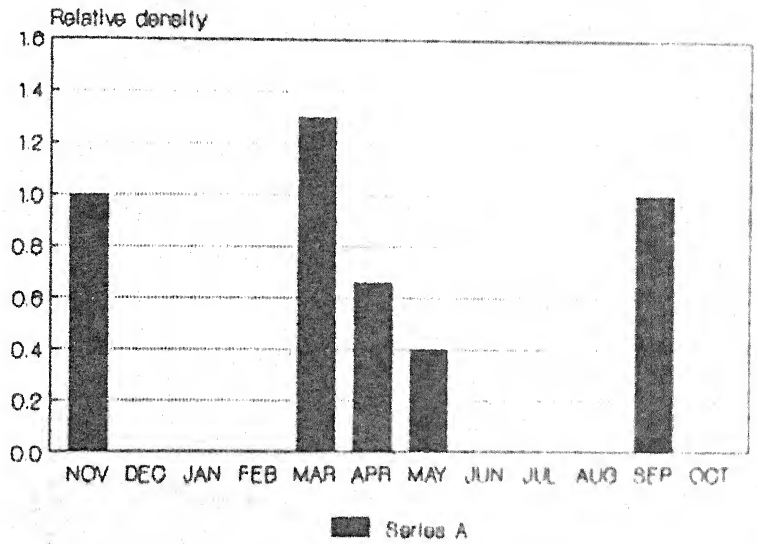



Fig. No. 8
201-250g.

Plate - 36

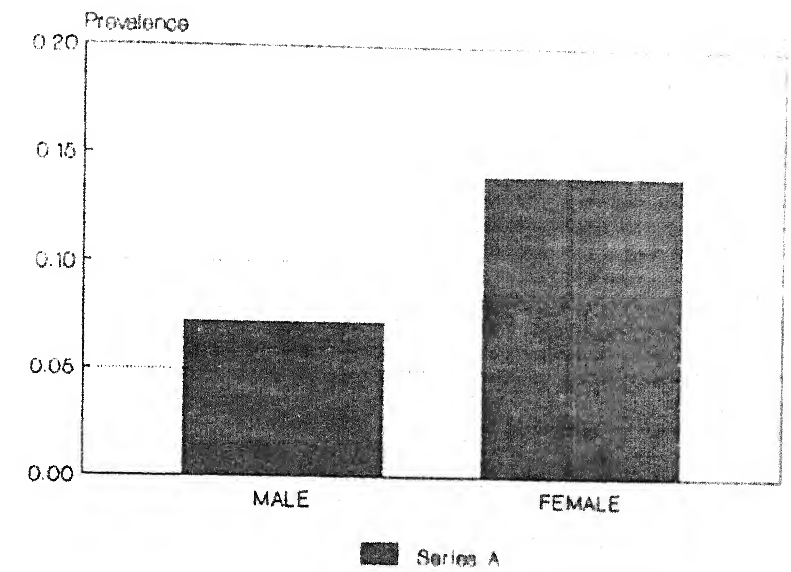


Fig. No. 1

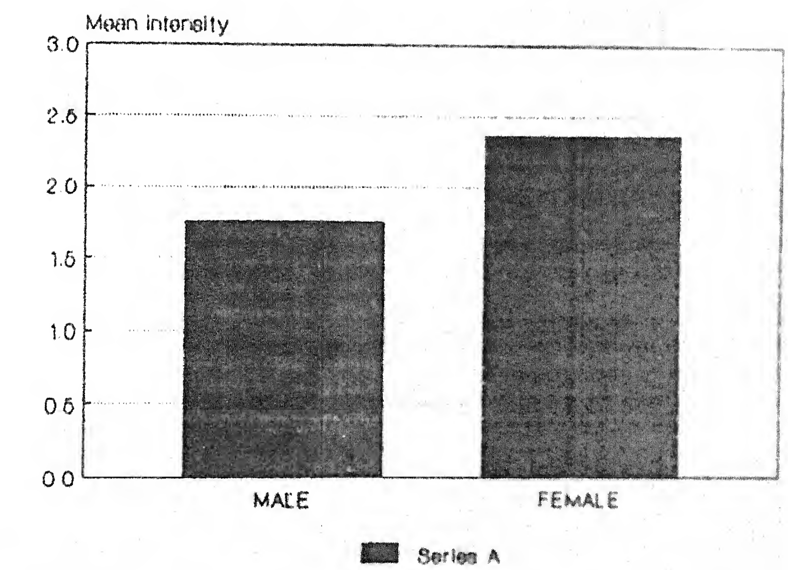


Fig. No. 2

Plate - 37

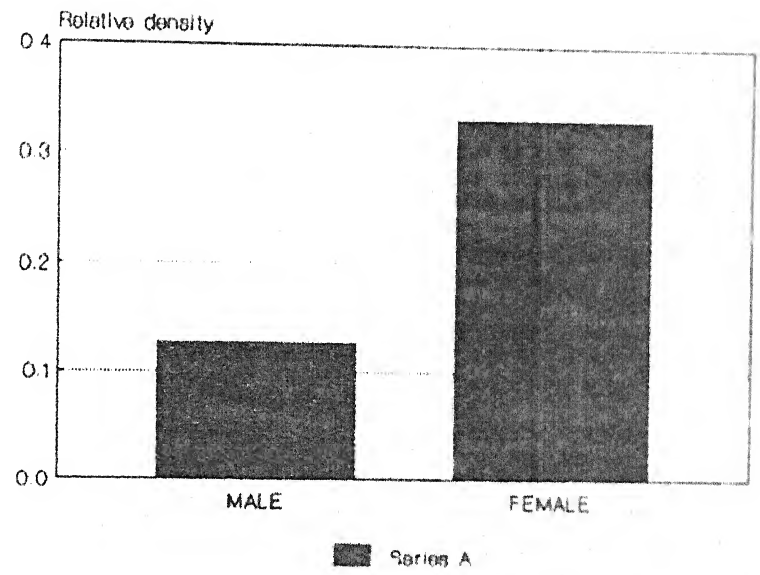



Fig. No. 3

Plate - 38

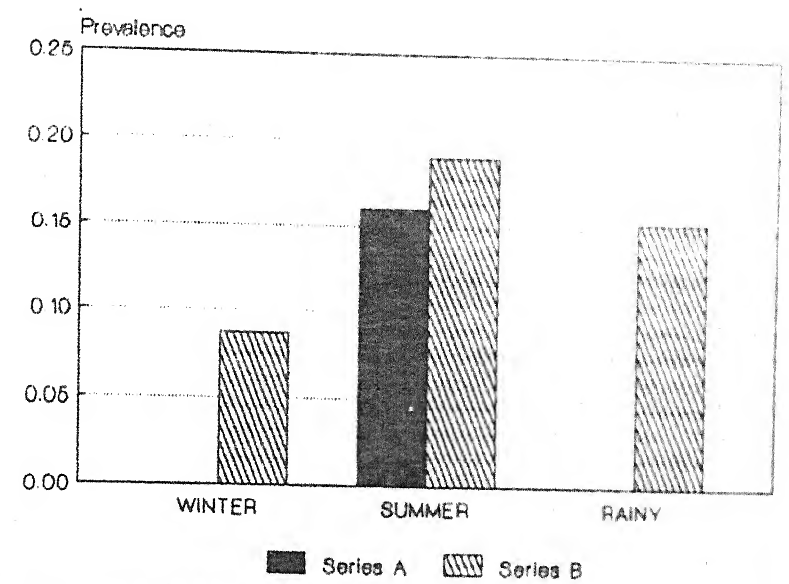



Fig. No.1 A: MALE B: FEMALE

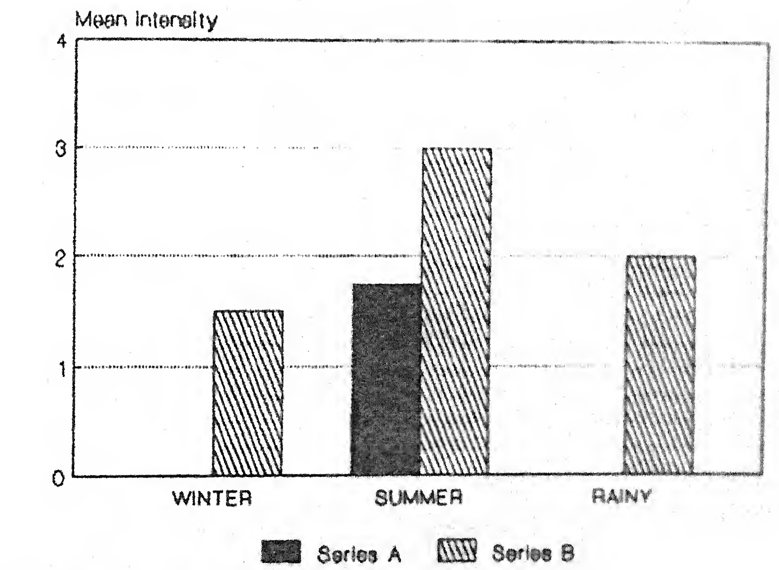



Fig. No.2 A: MALE B: FEMALE

Plate - 39

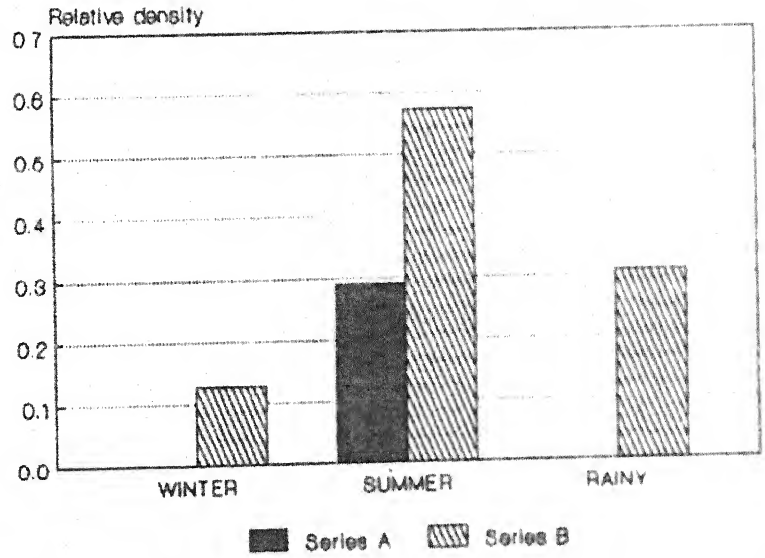


Fig. No.3 A: MALE B: FEMALE

Plate - 40

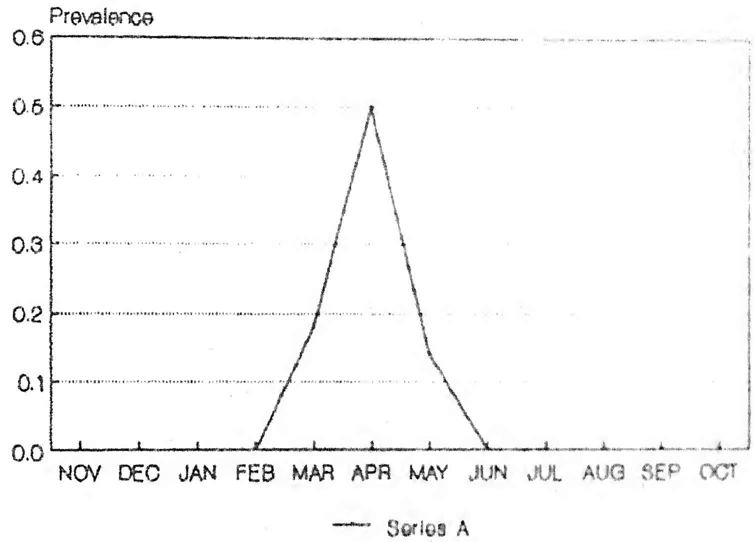



Fig. No. 1
Male

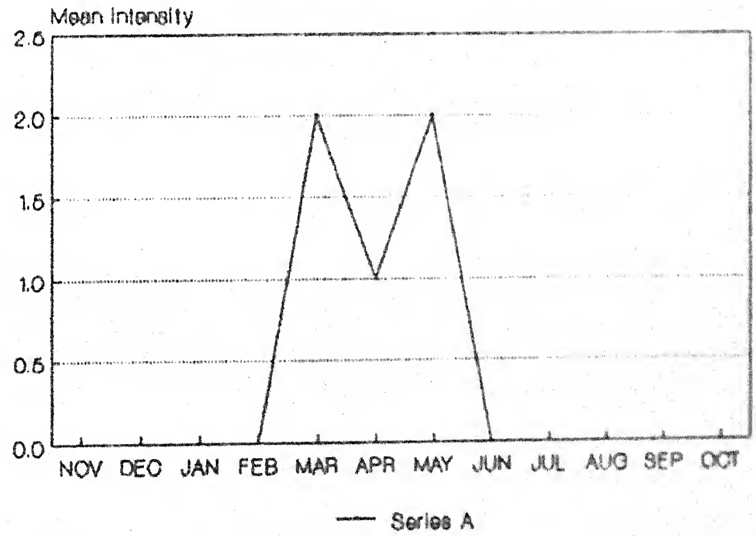



Fig. No.2
Male

Plate - 41

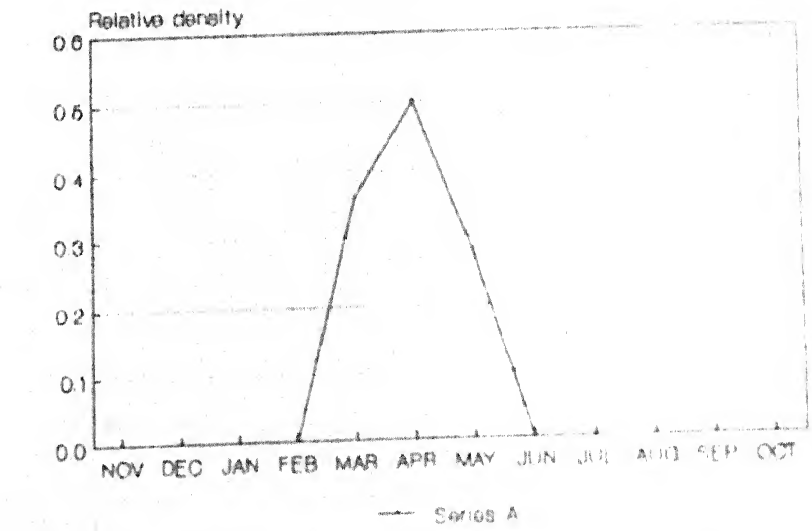



Fig. No. 3
Male

Plate - 42

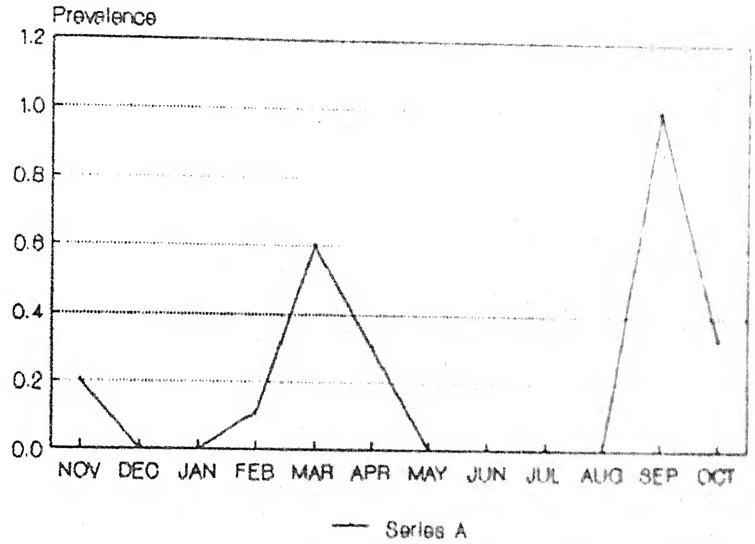



Fig. No. 1
Female

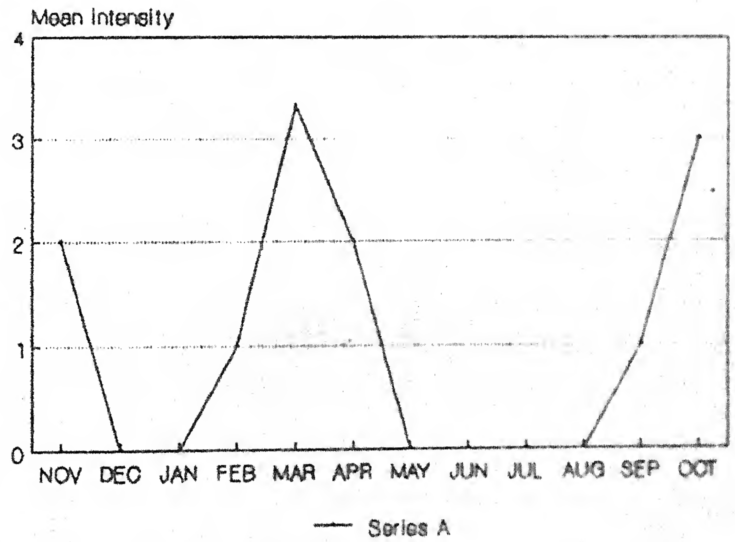



Fig. No. 2
Female

Plate - 43

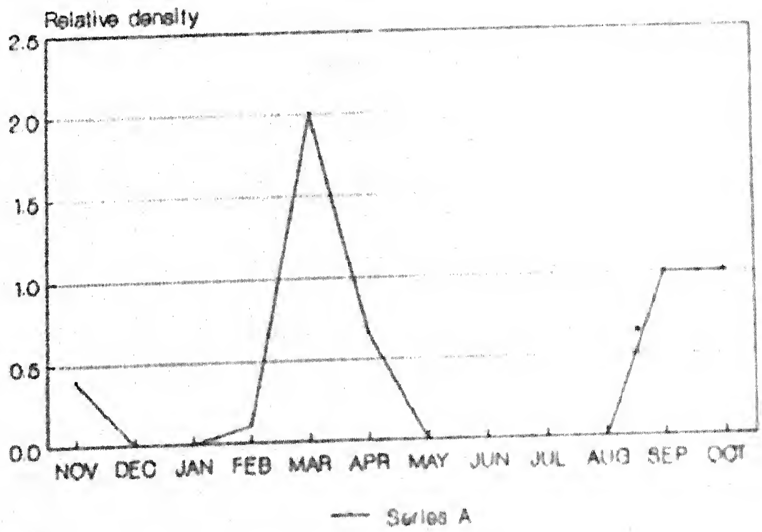



Fig. No. 3
Female

Plate - 44

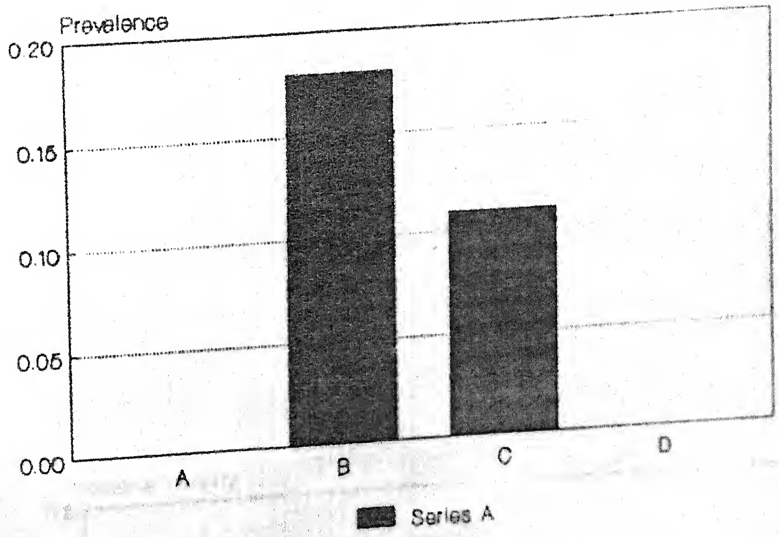



Fig. No.1 A 70-77'F B 78-85'F
C 86-93'F D 94-101'F

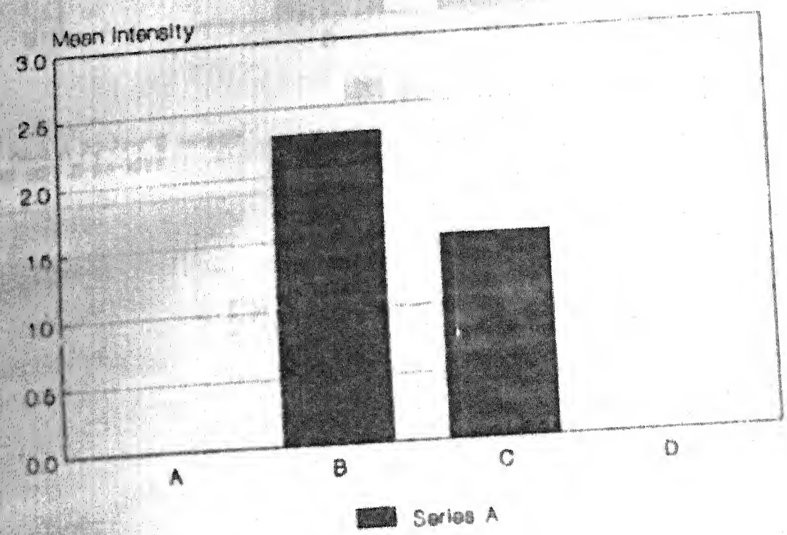



Fig. No.2 A 70-77'F B 78-85'F
C 86-93'F D 94-101'F

Plate - 45

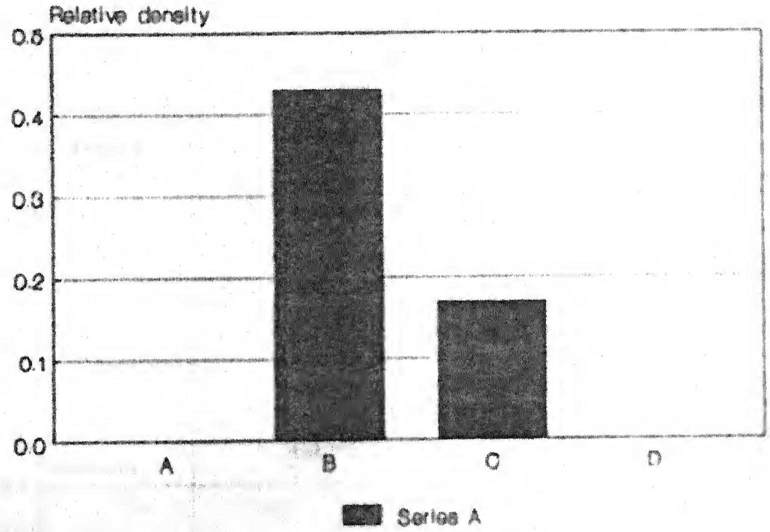



Fig. No.3 A 70-77°F B 78-85°F
C 86-93°F D 94-101°F

Plate - 46

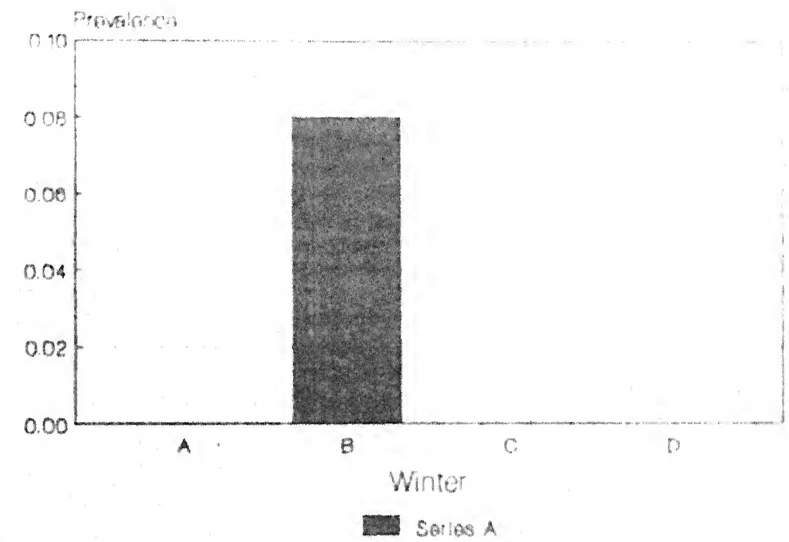



Fig.No.1 A 70-77'F B 78-85'F
C 86-93'F D 94-101'F

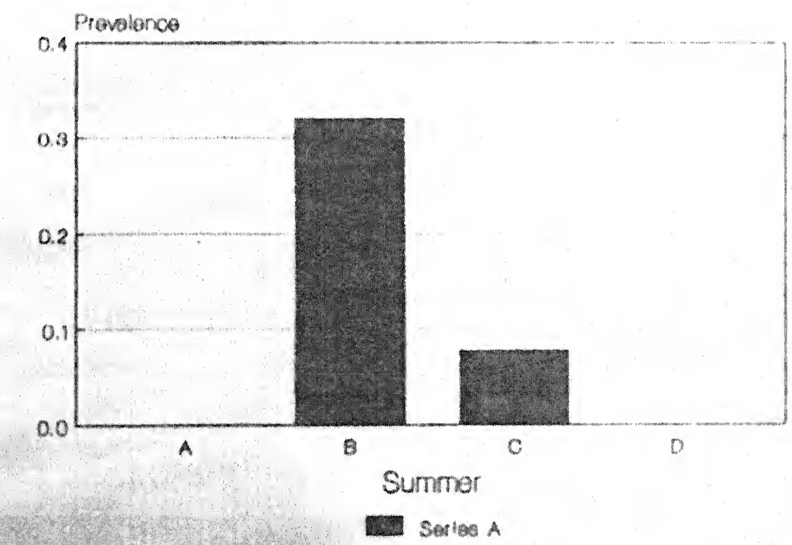



Fig. No.2 A 70-77'F B 78-85'F
C 86-93'F D 94-101'F

Plate - 47

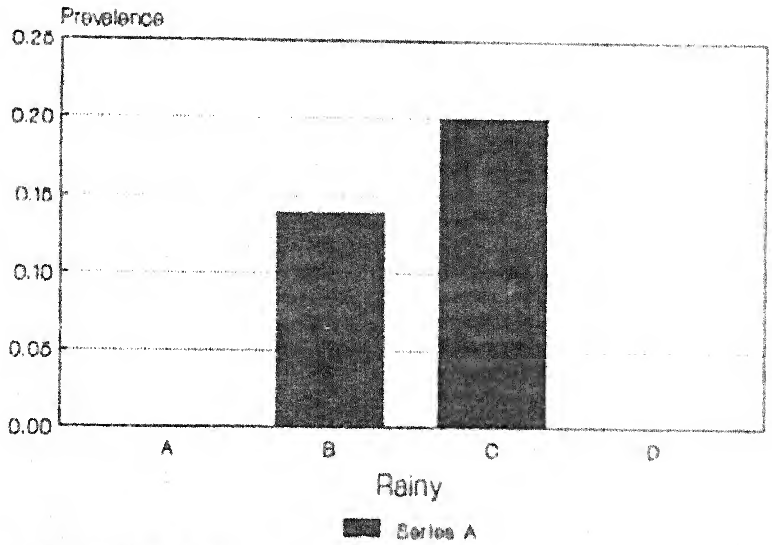



Fig. No.8 A 70-77'F B 78-85'F
C 86-90'F D 94-101'F

Plate - 48

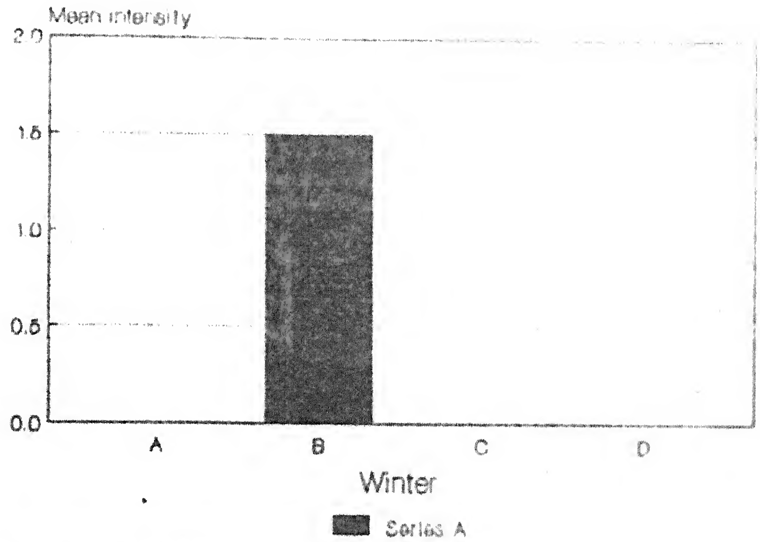



Fig. No.1 A 70 -77'F B 78-85'F
C 86-93'F D 94-101'F

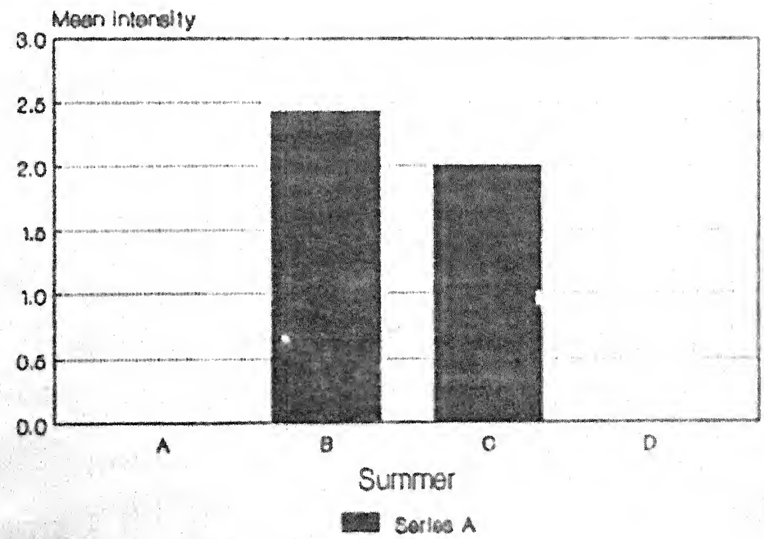



Fig. No.2 A 70-77'F B 78-85'F
C 86-93'F D 94-101'F

Plate - 49

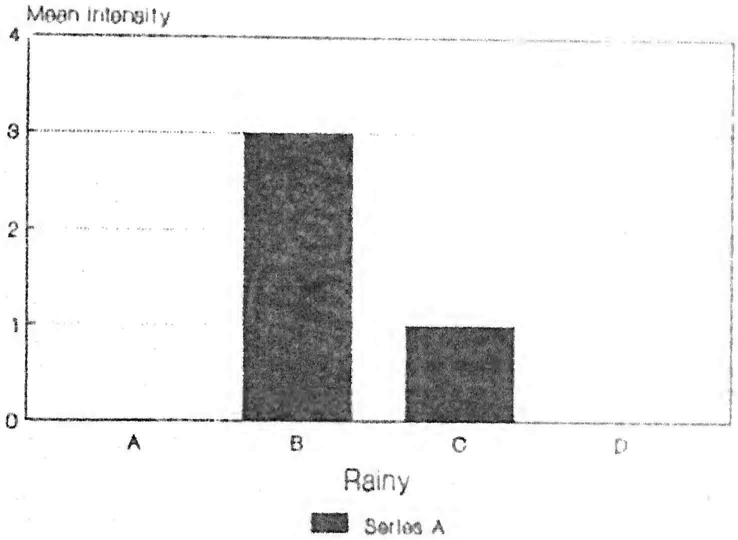


Fig. No.8 A 70-77°F B 78-85°F
C 86-93°F D 94-101°F

Plate - 50

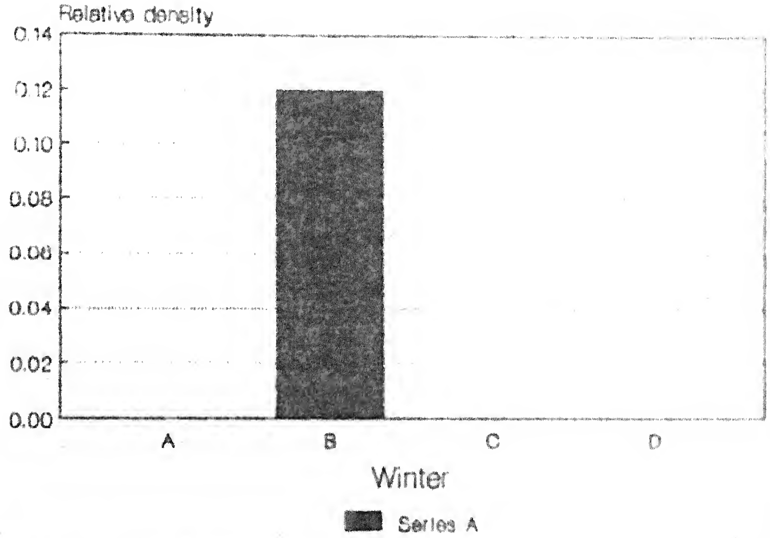



Fig. No.1 A 70-77'F B 78-85'F
C 86-93'F D 94-101'F

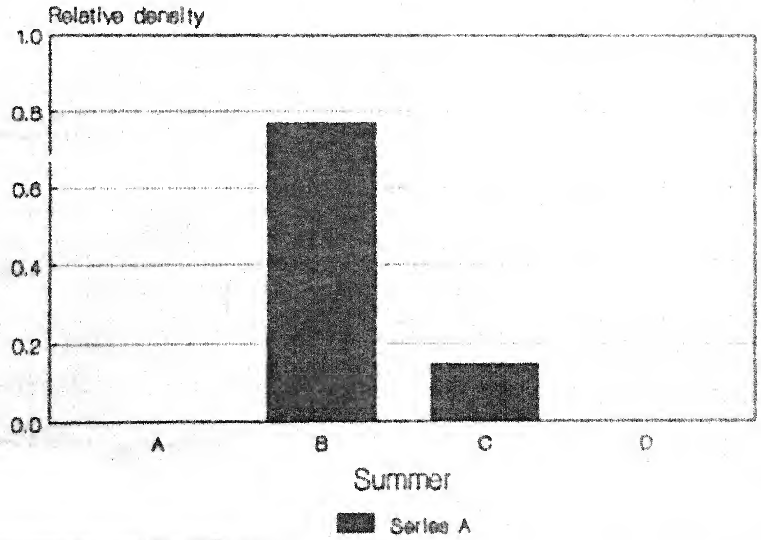



Fig. No.2 A 70-77'F B 78-85'F
C 86-93'F D 94-101'F

Plate - 51

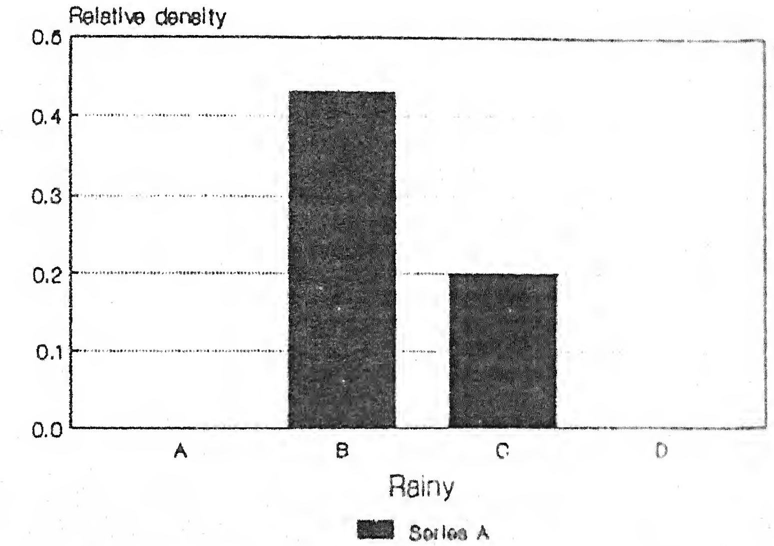



Fig. No.8 A 70-77'F B 78-85'F
C 86-93'F D 94-101'F

Plate - 52

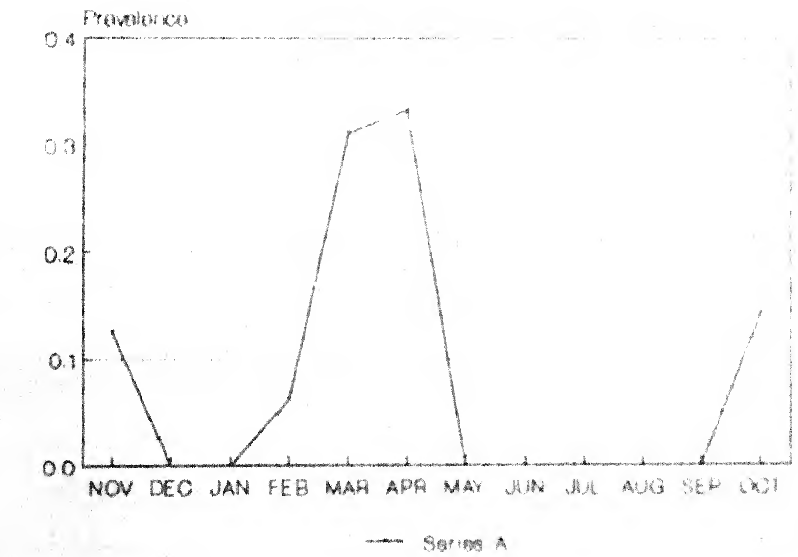



Fig. No. 1 78-86T

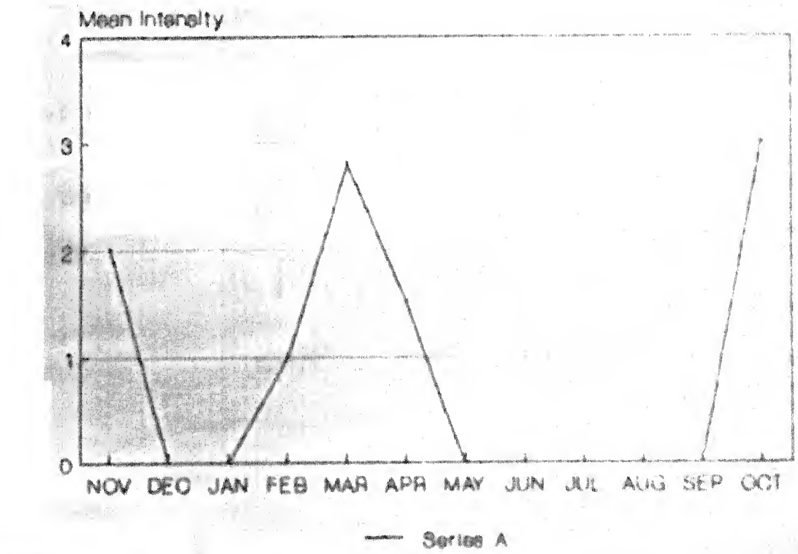



Fig. No. 2 78-86T

Plate - 53

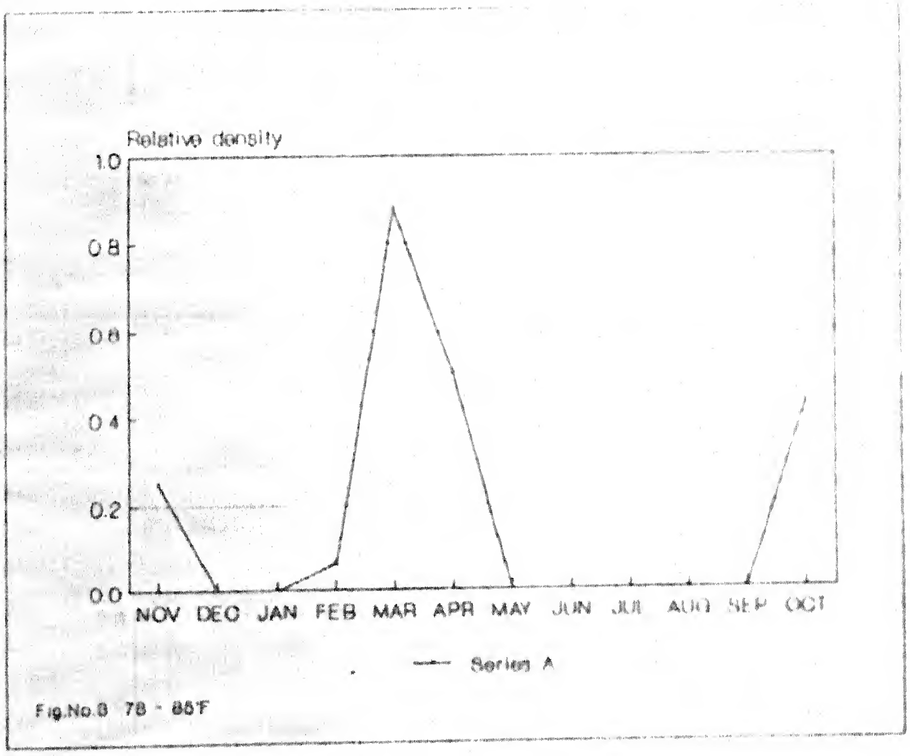

Relative density
1.0
0.8
0.6
0.4
0.2
0.0
NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT
Series A
Fig.No.8 78 - 85'F

Plate - 54

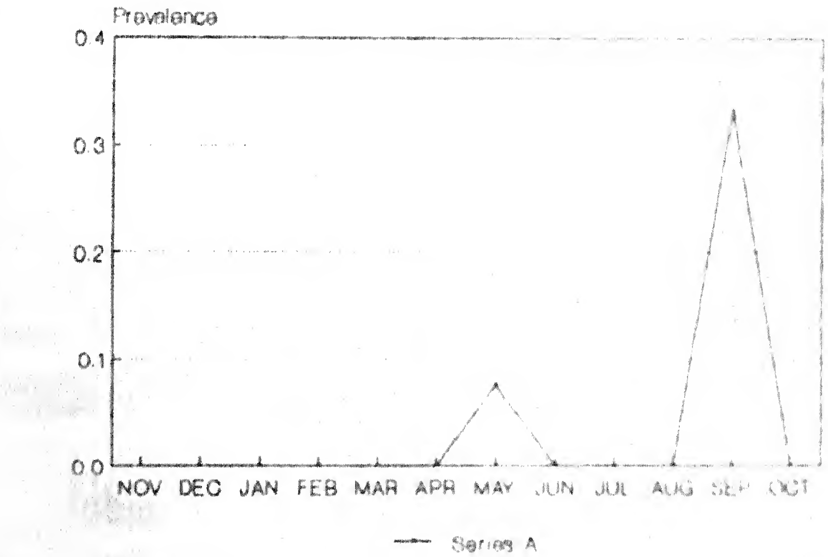



Fig.No.1 88 - 93'F

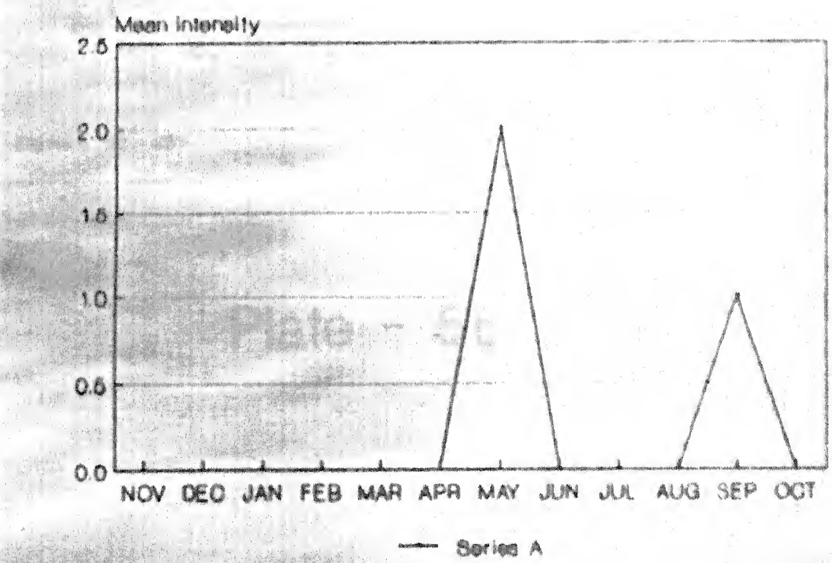



Fig.No.2 88 - 93'F

Plate - 55

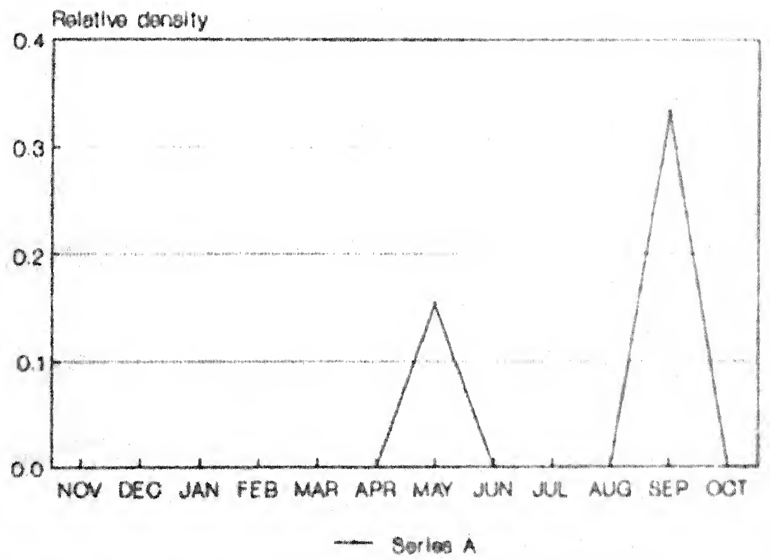



Fig.No.9 98 - 99'F

Plate - 56